COMMUNICATIONS TO THE BOARD OF AGRICULTURE, ON SUBJECTS RELATIVE TO THE HUSBANDRY...

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TO THE

BOARD OF AGRICULTURE;

ON SUBJECTS RELATIVE TO

THE HUSBANDRY,

AND

INTERNAL IMPROVEMENT

OF THE COUNTRY.

VOL. VII. PART I.

——— ARATRO
DIGNUS HONOS——— GEORG.

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ADVERTISEMENT.

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ADDRESS

TO THE

BOARD OF AGRICULTURE,

On the Progress made by that INSTITUTION *in promoting the Improvement of the Country,*

On Tuesday the 12th of June, 1810,

By SIR JOHN SINCLAIR, BART. *the* PRESIDENT.

GENTLEMEN,

AT no period since its first Establishment, has the Board of Agriculture been more successful, in carrying on the important objects for which it was constituted, than since I last had the honour of addressing you.* It is difficult, indeed, to comprehend within a moderate compass, the variety of important particulars which have come under its consideration. I shall endeavour briefly to state, under distinct heads, those which principally merit your attention.

I. *Implements.*

A number of implements, and communications regarding them, have been transmitted to the Board, among which the following are the most important. 1. A machine for weighing cattle, and other stock, by means of which their progress in fatting, and the value of the different sorts of food consumed by them, may be ascertained. This useful implement is invented by that ingenious mechanic Mr. Shepherd of Woburn, and is to be purchased at the moderate price of twenty guineas. 2. A threshing mill, invented by Messrs. Gowing and Andrews, of No. 219, Tottenham Court Road, a model of which has been presented to the Persian Ambassador, to be exhibited in his native country. 3. Some cart-wheels on a superior construction suggested by Mr. Stracey, of Parliament-street, who has directed his attention, with much success, to the improvement of wheel carriages. 4. An improved turnip drill, by Mr. Paterson near Dunfermline in Scotland, which, by an ingenious contrivance, waters, at the same time that it sows, the seed. 5. Communications

* The preceding Address was delivered on the 7th of June, 1808. It was thought unnecessary to deliver another Address in the year 1809, as Mr. Young the Secretary had given, in the course of that year, a very able Lecture, which was printed at the desire of the Board, "On the advantages that had "resulted from the Establishment of the Board of Agriculture."

have been received from Wales, regarding an improved hay rake, which, it is said, will greatly facilitate that operation in husbandry, so hazardous in wet seasons. 6. Mr. Manley's Expedition Plough, which was tried in the presence of a Committee of the Board, deserves also to be noticed, though its merits have not yet been fully ascertained. 7. Mr. Amos of Lincolnshire has sent in a paper, on the proper construction of ploughs, and other implements of husbandry, which has justly merited a place in our volume of Communications.

II. *Live Stock.*

1. The communications regarding live stock have been of considerable importance. Among these a paper drawn up by the President of the Royal Society deserves to be particularly noticed. It gives an account of the Merino sheep lately presented to his Majesty by the government of Spain, together with some particulars respecting the sheep formerly imported from that country, in the year 1791. This interesting work has been very generally circulated, and is inserted in the sixth volume of our Communications.* 2. On the suggestion of Mr. Young of Harley-street, supported by the recommendation of Mr. Hastings, application has been made to the Directors of the East India Company, for bringing over to this country specimens of the Cashmerian breed of sheep, from the wool of which, it is said, the finest shawls are made, and which seems to be a breed, the fleeces of which are bought to as great perfection for combing wool, as the Merino is for the clothing. 3. Some experiments have been made, at the desire of the Board, by Mr. Waters of Russel-square, and by the Rev. Dr. Cartwright, to ascertain the advantage of feeding both cattle and sheep with sugar and molasses; and 4. A number of interesting experiments have been made by that spirited agriculturist Mr. Curwen, for ascertaining the feeding properties of various breeds, which are likely to produce such important results, that the Board unanimously voted a premium of sixty guineas for so important a communication.

III. *Foreign Articles.*

It is difficult in time of war, to procure any new articles from foreign countries, but the Board has not been inattentive to that important object. 1. From the Asturias, the seed of a distinct species of wheat called Escanda, (which is said to be peculiarly calculated for a moist climate), has been procured. How far its cultivation ought to be extended in this country, especially in the western districts, will be the subject of future consideration. 2. By the flattering attention of his Sicilian Majesty, various sorts of wheat were transmitted from Sicily, together with specimens of the flour manufactured from each sort, and the mill-stones employed for that purpose; and 3. The

* It is one advantage which would result from increasing the Merino breed, that owing to the superior value of their fleeces they might be kept with advantage until they get to a proper age. The mutton they produced, in that case, would be fitter for delicate stomachs, than sheep brought to early maturity, and rapidly fattened. To bring sheep to perfection, the following properties ought to be united. 1. Form. 2. Fleece. 3. Fat. 4. Flesh, and 5. Flavour.

Count François de Neufchateau, President of the Agricultural Society of Paris, with a liberality becoming an enlightened and scientific age, transmitted to the Board, specimens of all the varieties of spring wheat cultivated in France, to the amount of above thirty in number. These specimens have been divided, and sent to several of the most distinguished agriculturists in the country; as the Duke of Bedford, Mr. Coke, Mr. Curwen, &c. who will be able to report to the Board, whether the cultivation of any of these sorts ought to be encouraged. 4. Here also it may be observed, that a respectable member of the Board, whose loss we have to lament, Philip Dehany, Esq. had for several years cultivated maize at Hayes near Bromley, several specimens of which he produced to the Board, from which it evidently appeared that maize might be grown in this country with advantage.

IV. *Domestic Productions.*

1. Any improvements in the art of growing, and also of preserving turnips when grown, are of the utmost importance. For producing so valuable a crop, a plan has been adopted by Mr. Blomefield of Northgate-Hall in Norfolk, which has never once failed in the course of seventeen years, though he annually grows turnips to the extent of 170 acres. His plan is, to sow at the rate of four pints of seed per acre, on light lands, and eight pints on the stronger. The additional expense is surely immaterial, if it secures so valuable a crop.* 2. Sir Robert Williams Vaughan, a respectable member of the Board, has ascertained, that Swedish Turnips can best be preserved in water, an inch above the root, and that they thus will long retain, in full perfection, their nutritive qualities. 3. A paper by Mr. Burrows of Weasenham, in Norfolk, places the cultivation of carrots in so clear and striking a point of view, that the growth of that important article cannot fail to be greatly extended, as soon as the knowledge which that paper contains, is properly disseminated; and, 4. The exertions which have been made by the Board, to extend the culture of the real spring or summer wheat, have been so successful, that it will probably form an æra in the agricultural history of the country. The increased culture of that grain, whether for the purpose of filling up any deficiency, or vacant spaces, in the winter sown wheat, or to be cultivated as spring corn instead of Barley, is the most effectual means, next to a more extended cultivation of potatoes, that has hitherto been devised, to prevent the risk of future scarcities, which, in fact, if due encouragement were given to agriculture, are no longer to be apprehended.

V. *Grasses.*

1. The discovery of a grass that would answer the purposes of rye grass, without being liable to the same objections, more especially in regard to exhausting the ground, &c. has long been anxiously wished for, and the object is likely to be obtained by the cultivation of

* Of course the land is in good tilth and heart, by oil-cake and muck; and the land is fresh and moist, so that the plants come up together, otherwise the fly would take them as they come up.

cocksfoot, which grows naturally on all our best pastures, and the seed of which can every where be gathered, more especially in woods and plantations. From an experiment made by Mr. Money Hill, the culture of this grass is likely to prove an advantageous mode of improving commons.* 2. Some experiments are also to be tried this season, for ascertaining the value of the Fiorin grass in this country, of which we have heard, for some time past, such favourable accounts from Ireland.

VI. *Premiums.*

Besides the articles above enumerated, for several of which premiums have been given, there are other sources of improvement for which rewards have been granted by the Board of Agriculture. 1. Sir Charles Merrik Burrell has received the gold medal for a very important experiment in soiling cattle, a practice which cannot be too much recommended. 2. William Robertson, Esq. of Ladykirk in Berwickshire, has received the same mark of attention from the Board, for his having very successfully drained a considerable tract of land. 3. An embankment by Mr. Sherriff of Kinmylees, near Inverness, was rewarded with a piece of plate. 4. Mr. Brodie of Garvald near Haddington, had also a piece of plate voted to him, for an able paper on weeding, the result of much attention to that subject; and, 5. Charles Duncombe, Esq. of Duncombe Park in Yorkshire, has received the gold medal, for an extensive improvement of waste lands, a very satisfactory account of which was transmitted by him to the Board.

VII. *Miscellaneous Articles.*

The attention of the Board has also been directed, to various particulars of a miscellaneous nature. 1. Its patronage has been given to a mineralogical survey of Shropshire, proposed to be drawn up by Arthur Aiken, Esq. an undertaking for accomplishing which he is considered to be peculiarly well qualified, and which is the first attempt of the sort on a regular and extensive plan. 2. In the course of this session, the Board have had the satisfaction of hearing two Lectures from its Secretary, on Manures, and on the Improvement of Waste Lands, both of which were distinguished by that information and

* Mr. Money Hill pared and burnt one acre of the worst part of a pasture field, of nearly fifteen acres, about the year 1806, spread the ashes on the surface, and without ploughing, sowed, on the 30th of April, upon the ashes, two bushels of cocksfoot, and thirty pounds of Dutch clover. He kept, by hurdles, all stock from it until the 20th August following; he then took away the hurdles, and allowed it to be fed with sheep, until the first of November following; no bullock or horse fed upon it for one year; it was then, and has ever since been pastured like the rest of the field, by cattle and sheep, and from its present appearance (28th April, 1810), in regard both of quality and abundance, would evidently maintain double the stock of any part of the field. Any common may thus be improved at a small expense, but draining is necessary. Four pounds of poa pratensis, and four pounds of poa trivialis would be a good addition to the cocksfoot and the Dutch clover. Rolling is useful, and it should be pastured with sheep and young cattle, to give firmness against frost.

ability which mark his literary labours; it was thought necessary, therefore, that such useful papers should be printed for the information of the Public; and 3. It is with much satisfaction I add, that Mr. Davy, whose merit and genius are too well known to require any eulogium in this place, has undertaken, in the course of this year, to publish those Lectures on agricultural topics, which have so frequently rivetted the attention of the members of the Board, and which will throw a new light on the science of agriculture.

VIII. *Transferring useful Practices from one District to another.*

It is well known to have ever been a favourite object of the Board, to transfer the valuable knowledge, and the useful practices of one part of the kingdom to another, by which both may be mutually benefitted. Water meadows, for instance, have been long known in the western districts, but were erroneously considered inapplicable to the eastern. By the encouragement given by the Board of Agriculture, that mistaken idea has been completely overturned, and the Board has directed me to present two Norfolk farmers on the estate of Mr. Coke, (Mr. Beck of West Lexham, and Mr. Purdy of Castle-acre), with premiums, for their successful exertions in forming water meadows on their respective farms. Irrigation is perhaps the greatest improvement that can be introduced into the Eastern counties. In Norfolk alone, there are above fifty thousand acres, capable of being converted into water meadow, which, in that state of improvement, would be invaluable in a district, where so many sheep are bred. But great as that object is, it is of much inferior importance, compared to the advantage that would be derived from transferring an improved arable system from the Eastern to the Western counties. I hope, by the aid of that public spirited, and useful institution, the Bath and West of England Agricultural Society, that so great an object may be speedily accomplished. It is peculiarly necessary in those districts, to improve the mode of cultivating clover layers, when appropriated to the growth of wheat. At present a failure too often takes place; but by adopting the improved system of Norfolk, in conducting that operation, every risk of disappointment may be prevented.*

* The following is an abstract of the Norfolk mode of cultivating clover layers. 1. Stock the clover layer very hard with sheep and young cattle, so as not to leave on it, when it is ploughed up, the least vestige of herbage, or a single blade of grass; for if any herbage remains, it makes the ground puffy, and furnishes food for grubs and other vermin. 2. Plough up the layer in the end of August or beginning of September, from four to five inches deep, as the soil will admit of it. The earlier this operation can be performed the better. 3. As soon as the land is ploughed, compress it with a heavy roller, and in about ten days, or as soon after as any rain has fallen, harrow and cross-harrow it, so as to secure a complete pulverization. 4. By thus ploughing early, a stale furrow for sowing is secured, which is essential for procuring an abundant crop, under the drill, or broad-cast husbandry. 5. The land must be sown as early as possible, and always between the 1st and 20th of October. 6. On clover layers, drilling at nine inches distance is preferable to broad-cast, or even dibbling, which is not necessary with a stale furrow, though it may be adviseable with a fresh one. Where the ground is much exposed, three

IX. *Highway Act.*

In obedience to the directions of the Board of Agriculture, every exertion has been made to improve the laws regarding the highways and turnpike roads of the kingdom. A bill for that purpose, containing a number of most useful regulations, passed the House of Commons; and there is every reason to hope, will receive the sanction of the legislature early in the course of the ensuing session.* Some doubts having still been entertained, regarding the propriety of enforcing the use of cylindrical wheels, in preference to the conical; to remove every objection to so necessary a system, a respectable corporation, (the Trustees of the Commercial road in the parish of Stepney), have agreed to try the

bushels of seed ought to be given;† but in sheltered spots from eight to ten pecks, four pecks to the bushel, is sufficient. No muck or oil-cake necessary. 7. The seed should be harrowed in with a very light harrow. 8. When the wheat is up, a heavy roller should be used in the months of October or November; for though some contend, that the wind has more power to injure the blade, when the land is smooth, yet it is certain that the rolling has the effect of preserving the root from injury, and of destroying the grub. 9. The heavy roller should also be used in dry weather, in the end of February or beginning of March, and the drill harrow in March. 10. The crop should be hand-hoed in March, the expense from 2*s.* to 2*s.* 6*d.* per acre; and if it is necessary, it should be hand-hoed a second time. Some, indeed, also use the drill harrow, after the first hoeing, but this is not always the case.

Had this process been adopted all over the kingdom in the course of last autumn, thousands of acres, which have been unfortunately ploughed up, from the destruction of the plant of wheat, or where the crop, though left standing, is likely to be deficient, would have this year produced an abundant harvest; and it is in the power of those farmers, who will adopt this plan, never again to suffer any damage from such failure, at least to the same extent. In regard to frost, it only throws out the plant when the land is puffy, which is easily prevented by compressing the soil. To prevent the effects of frost also, the wheat should be sown before the 20th of October, and at a proper depth, not exceeding two inches, in which case no danger from frost is to be apprehended. This is strongly in favour of drilling on a stale furrow, thoroughly pulverized, for the depth can then be regulated with great exactness. When the seed is sown deeper than two inches, the plant is weakened by its efforts to rise from a greater depth, and the frost has thus a more powerful effect upon it. Often, indeed, the first effort fails; but the wheat makes a second effort, which if the season is favourable, answers. Farmers should be extremely cautious therefore, not to plough up too hastily. The first shoot may be destroyed by the frost; the plant, however is not killed, but will make a second appearance in the course of the spring. It then rises again out of the ground from the coronal roots, which have been formed, and will produce a good crop; which, however, will not be ripe so soon, by a fortnight or three weeks, as a crop that had not been checked by the frost. The grub or wyre-worm also, may destroy the seminal fibres, but if the coronal roots are formed, these vermin may check the growth, but they will not destroy the plant.

* In carrying this bill through the Commons, the President derived much assistance, not only from several members of the Board, as Mr. Pole Carew, Mr. Davies Giddy, Mr. Spencer Stanhope, &c. but also from several public spirited members of Parliament, unconnected with this Institution, in particular Mr. Whitbread, Mr. Nicolson Calvert, Mr. George Vansittart, &c.

† Mr. Blomefield of Northgate-Hall often gives four bushels, being convinced that a thick plant is essential; it can easily be thinned if necessary.

necessary experiments, on a great scale, under the superintendance of that able mechanic, Mr. Cumming, by means of which, there is every reason to hope, that so important a question will be set at rest.

X. *Volume of Communications.*

Another volume of Communications to the Board, (the 6th), has recently been printed, containing a number of articles of great merit, among which, I beg leave more particularly to allude to the following. 1. A paper by the Bishop of Llandaff, on planting and waste lands, drawn up with the usual ability of that distinguished character. 2. Mr. Durno's account of the culture of hemp and flax in Russia, &c. 3. Papers on embankments by Lord Boringdon, Mr. Howard of Corby Castle, Mr. Maddocks of Caernarvonshire, and Admiral Bentinck. 4. A communication from Warren Hastings, Esq. on naked barley. 5. Colonel Mitford's observations on Grecian barley. 6. The sketch of a wier on the beach near Swansea, for the purpose of catching fish, communicated by Mr. Loveden. 7. Dr. Fothergill's observations on the fertilizing effects of gypsum. 8. Various experiments with spring wheat and other articles of considerable importance to agriculture; and, without dwelling on a number of other communications which would do credit to any publication; it may be proper to observe, that this volume contains an account of the system pursued by Mr. Gregg of Hertfordshire, on his farm of Coles; which is evidently superior to the husbandry of his neighbours, and will probably furnish useful hints to other districts in the kingdom.

XI. *County Reports.*

I have at last the pleasure of congratulating the Board, on the prospect of soon bringing to a successful termination, an undertaking by far the most laborious and important ever attempted by any institution, namely, the Reports drawn up, according to one uniform model, of the agricultural state of the different counties of Great Britain. It was impossible to expect, that every one of these Reports could be equally valuable, or that some objections might not be discovered both to the plan and to the execution. But the matter to be wondered at is, that, with funds so inadequate to the completion of such a number of reports, and the difficulty of finding persons competent to the task of executing them, they should ever have been finished. Should Parliament ever be inclined to have the kingdom surveyed another time, what a foundation is laid, in these Reports, for such an undertaking. Had any one of them been printed a century or two ago, it would have been considered a most important agricultural production, and searched for with avidity. As it is, taken in a collective point of view, (each of them considered as merely the separate chapter of a great work), they are of inestimable value.*

* The late Dr. James Anderson observes, that "in the course of little more that one year, the Board "of Agriculture had printed a body of authentic facts, respecting the agricultural and internal œconomy

XII. *General Reports*.

I have now to state an event, which has given me more pleasure, than any circumstance that has happened since the first establishment of the Board of Agriculture. I allude to a grant obtained from Parliament this year, to the amount of 2,500*l*. for drawing up a General Report of the Agriculture of Scotland. It is impossible, in this place, to enter into the particulars of the plan, or to detail the manner in which it is proposed to be executed. It may be sufficient to observe, that the great object of all the enquiries carried on by the Board, was, first to collect, and then to condense and systematize, all the knowledge that could be obtained, regarding the *existing* agricultural state of England and of Scotland respectively, and the means by which each might be improved. For that purpose a general Report, first of the agricultural state of Scotland; (which being the smaller kingdom, can be the more easily drawn up;) and next a General Report of England, is essential. Until that part of the original plan is completed, all the advantage which might reasonably be expected from such an establishment, cannot possibly be looked for. When that plan is accomplished, it will soon be found, in the words of the celebrated Bacon, "*that knowledge is power*," and that when a proper system of improvement has been once ascertained, the difficulties attending its being carried into execution, can be speedily and easily surmounted.

CONCLUSION.

I shall conclude, with observing that the increase of national prosperity must, in a great measure, depend, on the progress made in the science of agriculture, and of all the other useful arts; and where, by public attention, that knowledge is in a double ratio spread, a country must become infinitely more prosperous. Much for that purpose has been already effected, by the efforts of the Board of Agriculture, in the great department over which it presides; and already, from the spirit excited by that Institution, there is hardly a corner of the kingdom, that is not, at this time, in a progressive state of improvement; much, however, still remains to be accomplished. But if the measures, above alluded to, for drawing up general Reports of England and of Scotland respectively, were once completed; if the principles of every branch connected with husbandry were once thoroughly explained, and digested; if, by judicious laws, all the most material obstacles to the improvement of the country were removed; and indeed, if, in particular cases, even encouragement were given to promote great and useful exertions, the prosperity of the British empire, would increase with a rapidity, beyond all former example, and even our present heavy burthens would scarcely be felt.

"of this country, greater than was ever obtained in any other nation since the beginning of time;" and Dr. Coventry, Professor of Agriculture in the University of Edinburgh, declares, "that in the corrected reports and publications therewith connected, there is detailed more useful and distinct information on various branches of agriculture, and on rural concerns in general, than was in print before these were drawn up."

COMMUNICATIONS, &c.

No. I.

An Account of soiling Cattle on Green Food, from May 13 to Sept. 17, 1809, on a Clay Soil in the Weald of Sussex. By Sir Charles Merrik Burrell, *Bart.*

Number of Acres mown for soiling.

4½	Acres of lucerne mown twice	
3	Acres of clover ditto ditto	
2	Acres of grass ditto once	N.B. These 16 acres were second crops, the first having been mown and made into hay.
14	Acres of clover ditto ditto	
23½		
deduct 8	Acres for one crop of the 16 acres abovementioned as being made into hay, deducted from the above.	
15½	There remains fifteen acres and a half to be charged to soiling.	

Number of Cattle soiled, and for what Periods.

		Weeks.	No. of weeks to each description of stock.
Cart-horses -	11	18	198
Working oxen	11	18	198
Two yearling beasts	5	18	90
Four yr. old steers	1	18	18
	1	14	14
One yearlings -	6	11	66
Galloway runts supposed 4 yr. old	10	8	80
Six Sussex cows with five calves by their sides, which latter are not included in the calculation.	6	4	24
	51		51)688(13½ Weeks to each sort, excepting the fraction of one day.

The above fifteen acres and a half kept fifty-one head of cattle thirteen weeks and a half, which had they been pastured, and the usual allowance of land been allotted, of four acres to three head of cattle for six months, they would have required thirty-five acres and a quarter to have kept them the above time; so that the produce of nineteen acres and three quarters of land has been saved for making into hay, which yielded twenty-nine loads (tons) and a half of the best hay, at £3. per load standing on the land, being in value worth £88. 10*s.* which has been saved by soiling.

N. B. The whole of my land mown for hay this year, has fully averaged a load and a half per acre.

Soiling, Dr.	£.	s.
To one man mowing feed, &c. 18 weeks at 12*s.* per week	10	16
To one old lame and broken winded horse 18 weeks at 9*s.*	8	2
Six loads (trussed) of straw at 1*l.* 16*s* per load	10	16
Two waggon loads of stubble at 1*l.* per load	2	
One waggon load of fern	1	
	32	14
Deduct 4*s.* per week for preserving fences, and attending to the cattle, had they been pastured	3	12
	29	2

Per Contra, Cr.	£.	s.
By 302 cartloads (of 30 bushels) of dung, completely rotten, and equal to fatting dung at 5*s* per load	75	10
By 29½ loads of hay mown from 19½ acres of land, saved by soiling, at 3*l.* per load	88	10
	164	0
	29	2
Cr. balance	134	18

Additional Advantages attending the soiling System.

1st. It prevents damage not only to fences, but also to underwood, corn, &c. by breachy cattle. 2d. It prevents the danger of cattle being staked, or otherwise hurt, by breaking fences. 3d. It obviates all danger of animals being *bove* (or as it is otherwise expressed, *blown*,) a misfortune which I have been subjected to in pasturing cattle on clover, to a very serious degree. 4th. Two-yearling beasts are by this system made very tractable for work. 5th. The advantages to working beasts are scarcely to be calculated, as they are saved all the fatigue of gaining their food after their day's labour, and consequently keep themselves in far higher condition, and are able to do much more work. 6th. and lastly, it enables a farmer to raise great quantities of dung at a small expense, in situations where it is not to be purchased on any terms.

Remarks.

The two four-years old beasts (which were put to fatten) did not thrive so fast as might have been expected, owing to their being of an unkind breed, added to the very vicious disposition of one of them, which occasioned their being drafted at that age to fatten; whereas the two-yearling beasts which I bred myself from the most improved Sussex stock, throve in so particular a manner, as to surprise several good judges; and gave a strong evidence of the advantage of the soiling system. My yearlings were in very good condition; and my working oxen, as before observed, were (though very hard and constantly worked) remarkably full of flesh. My cows, I must however candidly state, did not do so well with their calves, as when turned out. This may be in some measure accounted for, in the propensity of the Sussex (improved) stock, to flesh rather than to afford much

milk. N. B. Their calves, it should be recollected, are not included in the calculation.

I beg leave in concluding to observe, that this experiment has been performed under some disadvantages; in the first place, I was not apprized till very late of the premium held out by the Board, and consequently had laid in no reserve of straw to meet the demand, or otherwise a much greater quantity of dung would have been raised; and, in the second place, the clay lands of the Weald of the county of Sussex are very late in producing any burthen of grass, from the natural coldness of the soil; and, necessarily, soiling cannot take place so early in the summer, as in the more genial and early districts. The event has however answered my most sanguine expectations, as it has not only tended greatly to my own advantage, but I trust also to that part of the county of Sussex in which I reside, many spirited farmers having expressed their intentions of pursuing the soiling system in future. And as a testimony of their sincerity have, in a new and neighbouring Agricultural Association, offered a premium for the most satisfactory and beneficial experiment in soiling, that may take place in the summer of the ensuing year.

Thus I have, being unwilling to take up your valuable time, detailed the circumstances of this experiment with as much brevity as the nature of the case will admit; and whether it may be deemed worthy of the attention of the Board of Agriculture or not, I shall at least feel the internal satisfaction of having contributed my mite to the best of my abilities for the benefit of agriculture, and the promotion of the praiseworthy objects of the Institution.

Knepp Castle Farm, Dec. 3d. 1809.

We hereby certify upon honour, that the Memoir accompanying this certificate, is, to the best of our knowledge and belief, correct in all its circumstances.

CHARLES MERRIK BURRELL, Owner and Occupier.
JAMES LANCASTER, Bailiff.

Witness, WALTER BURRELL, Landholder on the adjoining farm.

The following valuable Communication was sent to the Board of Agriculture, in Claim of the PREMIUM *for the* BREED AND FOOD OF CATTLE, *offered in the Year* 1808; *and for which the Board granted a Premium of Sixty Guineas. The Board feel much Satisfaction in printing a detail of Experiments conducted with so much exactness, and which reflect great honour on the Gentleman who so patriotically undertook them. It is hoped these Experiments will prove a Stimulus to other Gentlemen, to turn their Attention to a Subject of so much importance to the welfare of the Country, as the Subsistence of its Inhabitants.*

No. II.

To Sir John Sinclair, *Bart. M. P. President of the Board of Agriculture.*

DEAR SIR, *Workington Hall, November 25th,* 1809.

I HAVE the honour herewith of submitting to the Board, the result of an experiment made in feeding two years old heifers, of the following breeds,

No. 1. 2 Hereford.	No. 4. 2 Galloway.
No. 2. 2 Short-horned.	No. 5. 2 Long-horned.
No. 3. 2 Glamorgans.	No. 6. 2 Sussex.

After using every exertion in my power, I was disappointed in being able to procure Devons of two years old, that could be warranted not to be in calf. I was much mortified, also, that the quarter, where I had placed my reliance for west highlanders and other Scotch cattle, failed me.

The difficulties I encountered in procuring stock, will justify me in taking the liberty of suggesting to the Board, that in case of future experiments, it would be highly advisable to offer premiums to the breeders to induce them to furnish the best specimens, which are not to be purchased.

I have no hesitation in declaring myself incompetent to offer any opinion of my own, upon the merits of the respective breeds of cattle. From the marked difference which will be found to exist between the specimens of the same breed of cattle it is evident it would require a number of experiments to be made, before any conclusive opinion could be formed, of the superiority of one stock over another for early maturity and propensity to fatten. The mode of treatment for the first six months would make a most material difference in the maturity of the animal. To be able, therefore, to decide in a satisfactory manner, the calves of the different breeds should be taken and brought up together, taking care they had all the same treatment.

I have taken the weight of the animals as the criterion for estimating their respective value. I am sensible this is liable to objection, as some acquire weight of carcass, others in inside fat: I am not however aware of any better mode.

The facts are correctly given, which will enable others who are better qualified to draw their conclusions. The food which was given to the respective breeds was weighed with great care and attention three times a week. After some time the consumption of those of the same kind was found to vary so little, that no separate account was kept, but an equal portion set down to each of what was weighed to the different specimens. The accounts have been carefully revised, and I believe them to be perfectly correct.

I subjoin a report of the cattle at the commencement of the experiment, by gentlemen every way qualified to form an opinion upon the merits of the respective breeds.

Though the experiment will have failed in deciding the early maturity and propensity to fatten of the respective breeds, I trust it will afford some useful information as to the consumption of food, and increase of cattle. It furnishes likewise the most incontestible proof, that soiling and stall feeding is not prejudicial to the health of beasts. The whole of the stock were in the highest health, though constantly confined, except for a few minutes once a fortnight to be weighed. The two Herefords and the Sussex were purchased to breed from, and have done very well.

The continued wet as well as want of sun seem to have operated in depriving the second crop of clover of all its feeding qualities. The whole lost weight for one fortnight: this made a reduction of from two to three stone in each beast's ultimate weight.

It will appear evident, that to pay the feeder, the food should not cost above ixpence per day. From the estimated profit must be deducted risque, expence of capital, and taking to market, &c.

Situated as I was, it was out of my power to render any information to the Board as to the quantity or value of the manure. When straw is worth from 2*d.* to 3*d.* per stone, as little is allowed for litter as can be helped. I have no doubt the manure would in all instances greatly overpay all the expences attending feeding.

The urine may be turned to great account, by its being conducted into reservoirs, and from thence pumped upon earth. When this has been completely saturated, it is not inferior to any manure. For a two-shift system, which I am now carrying on, I find this a most essential resource, and I expect to make usually from fifteen hundred to two thousand tons.

It contributed greatly to the health and comfort of the cattle to have them now and then washed with black soap and warm water; all irritation in the skin was prevented, and they never lost their hair, as feeding cattle generally do.

One of the Sussex heifers proved with calf, which was a great disappointment; the other did uncommonly well for eight months, after which she fell off.

The value of green food must differ according to situation: my estimate is made on land worth 40s. per acre.

Should the Board wish any further experiment, I should be happy to offer my services to conduct the feeding, the specimens being furnished by the breeders.

I shall be most ready to give any further information or explanation the Board may require of the Tables annexed.

With great respect, I have the honour to be, dear Sir,

Your obedient humble servant,

J. C. CURWEN.

		Stone.	October 6th, 1808.	Time of arrival at Workington.	Distance travelled miles.	Remarks,
Hereford. - -	Red, - - - - -	64	Sent from Home Lacey,	Oct. 6	200	A good specimen—but a consideration ought to be had on account of being weighed immediately after travelling.
Ditto. - - - -	Dark red, - - - -	$91\frac{1}{2}$	Ditto. - -	—	—	
Short-horned. -	White eared, Red sided, -	$78\frac{1}{2}$	Sent by Mr. Mason, -	1	say 100	Forward in condition, but not a specimen of the best.
Ditto. - -	Speckled, Red and White sided.	90	Ditto. - -	—	—	
Spayed Glamorgan. -	Black and White rump, -	$52\frac{1}{2}$	Sent from Home Lacey,	Oct. 6	200	These Animals are in poor condition, and on account of being spayed we cannot say theirs will be a fair experiment.
Ditto. - -	Black and White speckled,	$61\frac{1}{2}$	Ditto. - -	—	—	
Galloway. - -	Black and White spot rump,	54	Sent by Col. Cuningham,	Aug. 1	80	These are in tolerably fair condition, and of different kinds; but both fair specimens of that breed.
Ditto. - -	Black, - - - -	54	Ditto. - - - -	—	—	
Long-horned. -	Red sided, - -	76	Sent by Mr. Barns, -	Oct. 6	30	A very good specimen of this breed, forward in condition.
Ditto. - -	White sided, - -	$74\frac{1}{2}$	——— Mr. Kirks, -	6	80	
Sussex. - -	Light red, - - -	$68\frac{1}{2}$	Mr. Ellman, - -	Aug 5	300	These Animals are well shaped, and in good condition.
Ditto. - -	Darker red, - - -	69	Ditto. - -	—	—	

WILLIAM DONKIN. WILLIAM CUNINGHAM.
THOMAS BATES. JOSEPH GIBSON.

No. 1.]

	Weight October 1, 1808.	Weight gained September 30, 1809.	Consumption of green food.	Ditto of Straw, Chaff, &c.	Ditto of Oil Cake.	Wate
	st. lb.	st. lb.	st. lb.	st. lb.	st. lb.	gal.
Hereford.						
No. 1.	64 0	22 0	2265 12	191 8	6 6	25
No. 2.	61 7	28 7				
Short Horned,						
No. 1.	78 7	25 7	2362 1	187 12	6 6	28
No. 2.	90 0	25 0			0 0	
Glamorgan.						
No. 1.	61 7	24 7	2307 0	186 12	6 6	26
No. 2.	52 7	20 7				
Sussex.	69 0	18 0	2268 2	107 8	0 0	2

Periods on

	4	4	12		19	0			
	3	4	12		14	4			8
	4	4	12		19	0			
	3	4	2		12	6			
	8	4	8		36	0			
	3	4	12		14	4			
June	6	5	0		30	0			
				Total of Cole seed	—		292	14	—
	4	5	4	Grass 1*d*. per stone	21	0			
	3	5	8		16	8			
	4	5	12		23	0			
	10	5	8		55	0			
	3	5	8		16	8			
July	4	5	12		23	0			
				Total of Grass	—		155	0	—
	4	5	8	Clover 1*d*. per stone	22	0			
	7	5	12		40	4			
	3	5	0		15	0			
	7	5	4		36	12			
	6	5	0		30	0			
August	2	4	12		9	8			
	3	5	0		15	0			
	18	5	4		94	8			
	3	5	0		15	0			
	5	5	4		26	4			
Sept.	6	4	4		25	8			
	3	4	4		12	12			
	4	5	12		33	0			
	3	3	12		11	4			
	14	4	4		59	8			
				Total of Clover	—		436	4	—
				Total Amount of Green Food.			2265	12	Of Straw

No. 3.] SHORT HORNE

Periods on which the several quantities of food were given.		Green food.		Estimated value of green food.	Green food for No. of days.		Total quantities of green food for number of days.		Straw ..d. per stone	Q.. o.. n..
	No. of days	st.	lb.		st.	lb	st.	lb.	lb.	st
Oct.	20	6	8	Carrot tops ½d. per st.	130	0			8	
	6	5	8		33	0			8	
				Total Carrot-tops,	—		163	0	—	
	5	5	4	Turnip-tops ¼d. per st.	26	4			8	
Nov	15	5	8		82	8			8	
				Total of Turnip-tops,	—		108	12	—	
	15	7	0	Turnips ¼d per stone,	105	0			8	
Dec.	5	7	8		37	8			8	
	4	6	0		24	0			8	
	7	8	0		56	0			8	
	8	9	4		74	0			8	
	7	9	0		63	0			8	
Jan.	7	9	8		66	8			8	
	6	9	8		57	0			8	
	7	8	11		60	13			8	
	4	9	0		36	0			8	
	4	8	6		33	8			8	
	3	9	0		27	0			8	
Feb.	4	9	8		38	0			8	
	6	10	0		60	0			8	
	4	9	8		38	0			8	
	4	8	8		34	0			4	
	4	9	0		36	0			4	
	4	8	8		34	0			4	
	2	8	12		17	8			4	
March	4	8	8		34	0			4	
				Total of Turnips,	—		935	13	—	
	9	8	8	Swedes ½d. per stone,	76	8			4	
	4	7	0		28	0			8	
	4	8	4		33	0			8	
	4	8	8		34	0			8	
	3	9	0		27	0			8	
	3	8	12		26	4			8	
				Total of Swedes,	—		224	12	—	
April	4	7	8	Cole-seed, ½d. per st.	30	0			8	
	12	6	4		75	0			8	
	3	6	0		18	0			8	
	4	5	12		23	0			8	
	3	5	0		15	0			8	
	[illegible]	[illegible]	[illegible]		[illegible]	0			8	

Remarks.

he estimate is made upon the quantity of given to the two animals of each breed.

he difference upon the whole period was ifling, as not to make any sensible varia-

arrot and Turnip-tops are above their e.

he Cattle, besides their daily cleaning, frequently washed with black soap and r, which kept their skins perfectly cool, contributed, there is no doubt, to their th and thriving.

halfpenny per Swedes is too little, but a penny for Cole rather too much; taking two together, the price is sufficient.

lament my supply of Swedes was so small, e Cattle made evidently the best progress them.

ole I consider the next food to Swedes.

rom an accidental illness of one of the g Horned, I found her to improve much bleeding. I tried the experiment upon rest, but did not find any sensible effects.

he weather, from the beginning of July, he 26th was dry; the clover of the first

		Total Amount of green foo

No. 4.]

Periods on which the several quantities of food were given.	Quantities of Green Food.		Estim... gr...
No. of days.	St.	lb	
Oct. 20	6	8	Carrot te
7	4	5	
4	5	4	
			Total c
Nov. 8	6	0	Turnip
7	5	5	
			Total o
15	7	0	Turnip
Dec. 4	7	0	
12	6	0	
4	7	2	
11	8	4	
Jan. 4	9	0	
3	8	0	
6	8	8	
5	6	12	
3	6	8	
3	7	8	
7	8	4	
Feb. 10	8	8	
4	8	0	
4	8	4	
3	8	4	
4	8	0	
3	8	4	
March 4	8	8	
9	6	0	
			Total
4	7	0	Swedes
14	8	0	
April 22	5	12	
10	5	0	
2	4	2	
6	4	12	
May 17	4	10	
14	4	8	
			Total o'
June 10	4	6	Grass 1*d.*
10	5	0	
10	5	4	
			Total c
July 8	5	0	Clover 1c
7	5	8	
16	5	0	
Aug. 5	5	12	
26	5	0	
Sept. 13	4	0	
3	3	12	
14	4	0	
			Tota
			Amount o

No. 5.]

Periods on which the several quantities of food were given		Green food.		Estimated value of green food.	Green food for No. of days.		Total quantities of green food for number of days
	No. of days.	st.	lb.		st.	lb	st.
Oct.	20	6	8	Carrot tops $\frac{1}{2}d$. per st.	130	0	
	7	5	0		35	0	
	4	4	4		17	0	
				Total Carrot-tops,	—		182
Nov.	9	6	4	Turnip-tops $\frac{1}{2}d$. per st.	56	4	
	7	5	0		35	0	
				Total of Turnip-tops,	—		91
	5	7	10	Turnips $\frac{1}{3}d$ per stone,	38	2	
	9	7	8		67	8	
Dec.	5	6	8		32	8	
	4	6	4		25	0	
	7	6	4		43	12	
	4	7	12		31	0	
	4	9	2		36	8	
	3	8	12		26	4	
	4	8	0		32	0	
Jan.	7	9	0		63	0	
	3	9	12		29	4	
	7	9	4		64	12	
	4	8	4		33	0	
	3	8	8		25	8	
	7	8	0		56	0	
Feb.	4	9	5		37	4	
	2	6	13		13	10	
	4	9	8		38	0	
	4	6	4		25	0	
	6	9	8		57	0	
	5	9	0		45	0	
	3	9	4		27	12	
				Total of Turnips,	—		847
March	7	8	12	Swedes $\frac{1}{2}d$. per stone,	61	4	
	6	7	0		42	0	
	4	8	0		32	0	
	8	8	8		68	0	
	3	9	0		27	0	
	3	8	8		25	8	
				Total of Swedes	—		255

					48	0		
				Total of Swedes	—		261	12
	4	5	8	Cole seed ½*d.* per st.	22	0		
	18	5	0		90	0		
May	6	5	0		30	0		
	22	5	4		115	8		
	3	4	8		13	8		
June	6	5	0		30	8		
	4	5	8		22	0		
				Total of Cole seed	—		323	0
	3	5	8	Grass 1*d.* per stone	16	8		
	4	5	12		23	0		
	7	6	0		42	0		
	6	5	8		33	0		
July	4	5	8		22	0		
				Total of Grass	—		136	8
	7	5	8	Clover 1*d.* per stone	38	8		
	20	5	8		100	0		
August	5	5	4		26	4		
	6	5	8		33	0		
	20	5	0		100	0		
Sept.	2	4	8		40	0		
	11	5	0		55	0		
	17	4	0		60	0		
				Total of Clover	—		392	12
Total Amount of Green Food.					—		2269	2

Of

Statement of the Gain and Loss of Experimental Cattle upon Green Food for Twelvemonths.

		Carrot-tops 29 days. Total gain.	Per day.	Loss.	Turnip-tops 37. Total gain.	Per day.	Loss.	Turnips 91. Total gain.	Per day.	Loss.
		l. s. d.	l. s. d.	l. s. d.	l. s. d.	l. s. d.	l. s. d.	l. s. d.	l. s. d.	
Hereford, No.	1	2 0 0	0 1 3½	—	0 9 6	0 0 0½	—	5 10 0	0 1 0	—
Ditto,	2	—	—	5 8 6	—	—	0 8 6	8 3 4	0 1 4	—
Short-horned,	1	—	—	3 0 0	2 7 6	0 1 3	—	4 3 0	0 10 10¼	—
Ditto,	2	—	—	2 7 0	0 6 8	0 0 2¼	—	7 9 0	0 1 2¼	—
Glamorgan,	1	1 7 0	0 0 11½	—	4 0 0	0 1 7	—	5 8 0	0 1 1½	—
Ditto, -	2	—	—	1 7 0	1 1 0	0 0 6½	—	5 5 0	0 1 1	—
Galloway,	1	—	—	—	1 7 0	0 0 9	—	2 7 0	0 0 6	—
Ditto,	2	1 7 0	0 0 11½	—	3 7 0	0 1 4½	—	7 7 0	0 1 2½	—
Long-horned,	1	2 0 0	0 1 0	—	—	—	0 9 0	4 0 0	0 0 9	—
Ditto,	2	1 7 0	0 0 11½	—	—	—	0 9 0	5 13 0	0 1 0	—
Sussex, -		—	—	3 0 0	3 12 0	0 1 7¼	—	5 10 0	0 1 2	—

		Sweeds 32. Total gain.	Per day.	Loss.	Cole Seed 59. Total gain.	Per day.	Loss.	Grass 28. Total gain.	Per day.	Loss.	Clover 87. Total gain.	Per day.	Loss.
		l. s. d.	l. s. d.		l. s. d.	l. s. d.	l. s. d.	l. s. d.	l. s. d.		l. s. d.	l. s. d.	
Hereford, No.	1	1 9 0	0 0 11½	—	4 9 10	0 1 4½	—	2 9 0	0 1 3	—	4 6 0	0 0 11¼	—
Ditto,	2	0 11 0	0 0 5½	—	7 3 0	0 1 11	—	2 1 0	0 1 2½	—	7 6 0	0 1 3	—
Short-horned,	1	1 0 0	0 0 7	—	4 6 0	0 1 0¼	—	6 4 0	0 3 2	—	4 9 0	0 1 0	—
Ditto,	2	4 0 0	0 2 0	—	3 12 0	0 1 3½	—	2 4 0	0 1 4	—	4 0 0	0 0 10¼	—
Glamorgan,	1	3 6 0	0 1 7	—	1 12 8	0 0 7	—	4 2 8	0 2 0½	—	3 9 0	0 0 9¼	—
Ditto, -	2	3 6 0	0 1 7	—	3 3 0	0 1 0	—	3 7 0	0 2 0	—	3 0 0	0 0 7¼	—
Galloway,	1	3 0 0	0 1 3¼	—	3 7 0	0 1 1	—	2 0 0	0 1 0	—	1 0 0	0 0 2½	—
Ditto,	2	2 0 0	0 1 2	—	4 0 0	0 1 3	—	3 0 0	0 1 8	—	4 0 0	0 0 10	—
Long-horned,	1	1 10 0	0 1 0	—	1 2 0	0 0 4¼	—	2 12 0	0 1 0	—	4 9 0	0 1 0	—
Ditto,	2	2 2 0	0 1 3	—	—	—	0 7 0	4 12 8	0 2 7	—	5 13 8	0 1 3¼	—
Sussex, -		2 2 0	0 1 3	—	3 2 8	0 1 0	—	1 10 0	0 1 1½	—	3 0 0	0 0 7¼	—

No. III.

Observations, by Mr. Cumming, *of Pentonville, on the Causes that first occasioned the bending of the Axles of Wheel Carriages; stating the Progress of the principal Improvements in the Construction of Wheels; and how the bending of the Axis, has introduced in succession, the Splay of the Wheels, the Dishing of the Spokes, and the conical Rim; and, generally, pointing out the Reasons, that rendered the bending of the Axil advantageous in former Times, and very unfavourable under the present Circumstances of the Roads: and that the Change of System arises from the Change of those Circumstances, not from any difference of Opinion from ancient Authority.*

1. It is well known that all the roads of this country were at first only foot paths, and afterwards became bridle ways; and that for very many years, all the internal traffic was carried on with pack-horses. And the roads receiving little or no repairs, they remained for some ages so deep and narrow, that they had in many places more the appearance of ditches, than of roads.

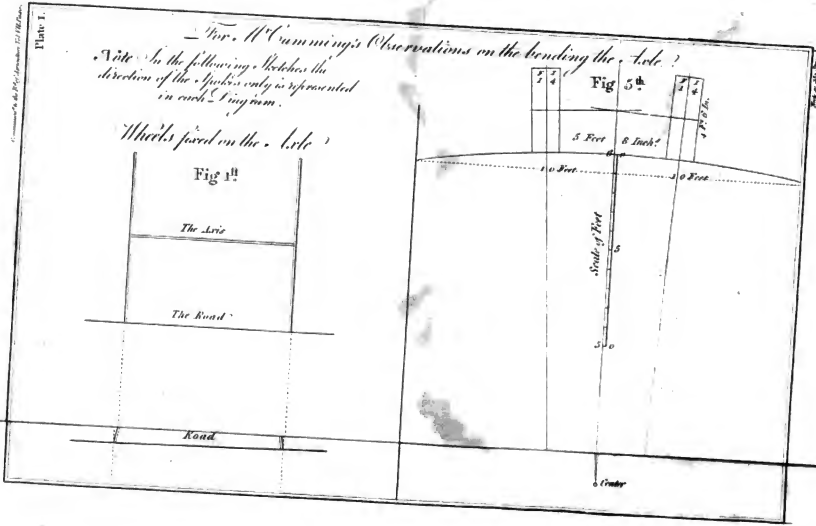
2. And it was absolutely necessary that under such circumstances, all carriages that attempted to travel these roads, should have their wheels so close to each other, as to come within those tracks. But the advantages of wheel carriages becoming every day more evident, and the distance of the wheels thus limited, ingenuity was fully engaged in devising the best means of enlarging the bodies of wheel carriages, so as to render them in some degree fit for the purposes of commerce on the same narrow roads.

3. The first carriages had their wheels fixed on the ends of the axis; and it turned with them. See Fig. 1. Plate I. And it is obvious that wheels so fixed to the ends of the axis, must always be parallel, and at the same distance from each other at the top and at the bottom; and this circumstance prevented any extension of the body of the carriage beyond the width of the track of the wheels on the road, without totally altering the system of the wheels and axis.

Plate I.

For Mr. Cumming's Observations on the bending the Axle.

Note. In the following Sketches the direction of the Spokes only is represented in each Diagram.



4. And it probably required a greater degree of ingenuity than is generally supposed, to foresee the advantages that might be gained by fixing the axis immoveably to the body of the carriage, and making the wheels to turn independently on its ends.

5. By making the wheels to turn independently on the ends of the axis, it was no longer necessary that the axis should be straight, or the wheels remain parallel to each other; and by making the ends of the axis to incline downwards, the wheels were made to *splay*, that is, to stand wider, or more distant from each other, at the top, than on the surface of the road; and by that means some room was gained for the body of the carriage without widening the track of the wheels, or the immediate necessity of widening the road. See Fig. 2. Plate I.

6. By viewing the figure, it appears, that the wheels converge below the axis, as much as they diverge above it: and that, although the advantage of gaining room for the body is obtained by bending this axis, the risque of overturning is increased, by bringing the wheels so much closer together on the surface of the road; and probably the remedy for this evil, without loosing the advantage of the room gained above the axis, was not immediately discovered.

7. But in process of time, the unfavourable position of the spokes, at the under part of the wheel, and the danger of oversetting, by the nearness of the under part of the wheels to each other on the road, suggested the necessity of inserting the spokes into the nave, in such manner, that each spoke should stand upright, when it comes immediately below the axis. Fig. 3. Plate I. And when all the spokes are thus inserted, it extends the base on which the carriage is supported; it puts the spokes that support the load in a more favourable position to sustain the perpendicular pressure; and the obliquity of all the spokes towards the front of the wheel, gives it a concave appearance, which is called the *dishing* of the wheel.

8. And in addition to the advantages that have already been mentioned, the obliquity of the spokes, or *dishing*, gains as much additional room above the axis, as it gives additional breadth to the base; it gives additional stability to the carriage; and, moreover, the dished form of the spokes adds much stiffness and strength to the wheel: and this additional strength, which probably was unexpectedly gained by dishing the wheels, from the arcular form which the spokes and the rim together give, is the only rational argument which at this time can be used for continuing the bended axis. But those who thoroughly understand the advantages that are

gained by dishing the spokes with the bended axis, must see, that the same advantage may be gained in a much higher degree, with the straight axis, upright wheel, and alternate spokes, which may form a double dishing to every wheel.

9. All that is here said of the splay of the wheels, the obliquity of the spokes, the dishing of the wheels, the extension of the base, and the additional room gained for the body of the carriage, will be better understood by inspecting Fig. 3, and comparing it with Fig. 2. Plate I.

10. To shew what was the nature of the limitations in the breadth of the road, which appear to have occasioned the bending of the axle, to gain room to the body; we here transcribe a short description of the state of the roads, from a pamphlet printed—So late as "40 years ago, the roads of England were in a most deplorable condition; those that were narrow, were narrow indeed; often to that "degree that the stocks (naves) of the wheels bore hard against the banks on "both sides."—This fully shows the necessity that men were under of discovering some means of enlarging the carriage without lengthening the axis, or extending the width of any part below the axis.

11. In the Communications to the Committee of the House of Commons, two gentlemen, whose observations are entitled to particular attention, * impute the bending of the axis, to reasons different to what have been here offered, and different from each other.

12. In the Appendix, No. II. page 22, to the first Report of June 1808, Mr. Walker says, "Greater loads increasing with greater trade, room in carriages "became an object; dished wheels were contrived, which gave room for the body "of the carriage, and set it upon a broader base," &c.

13. Here Mr. Walker supposes the dishing to have taken place before the bending of the axle; but there is every reason to believe, that the bending the axle first took place, and occasioned the splay of the wheels; and that dishing the spokes was an after thought, and subsequent improvement on the splay; as already stated in paragraph 7.

14. And it further appears by the fourth Diagram, Plate I. that dishing the wheels without bending the axis, would contract the room as much as the spokes deviate from the perpendicular, and by dishing the spokes without bending the axis, the space for the body of the carriage is contracted instead of being enlarged;

* Mr. Walker, and Mr. Ward.

but admitting the bend of the axis to have taken place as a matter of necessity, from the narrowness of the roads; the *splay* of the wheels, the *dishing*, and the *conical rim* must follow of course, as above stated. See Fig. 4. Plate I.

15. As a further illustration. Let a pair of upright wheels with a straight axis be made to roll in the same track as the dished wheels in Fig. 4.; and the upright wheels, (having no obliquity of the spokes) will have more room above the axil, than the dished wheels in Fig. 4. in a road, the breadth of which is limited by such deep rutts as frequently happened in the ancient roads, and may yet be met with in some remote places, and in bye lanes.

16. It may therefore fairly be inferred, that dishing the wheels, without a previous bending of the axis, cannot gain room to the body of the carriage; but, on the contrary, that dishing the wheels with a straight axis, when their distance on the road is not increased, diminishes the room for the body.

17. Mr. Walker further says, "But the want of room still increasing, the ends "of the axles were bent downwards as a remedy, as well as for strength; for as a "wheel is but a circular prop, the more perpendicular it stands under its load, the "better it sustains it," &c.

18. Here Mr. Walker again maintains, that the bending of the axis was subsequent to the *dishing*; but it is evident, that the bending of the axis first took place, and that such bending rendered the dishing necessary, as before stated (7.); for unless the axis is bent, the wheels can have no *splay*; and if the wheels have no splay, there will be no occasion for dishing: for the spokes, having no *splay*, they will stand upright under the axis without dishing. See Fig. 3.

19. It is evident, then, that the *dishing* did not take place before the bending of the axis; but that, on the contrary, the bending of the axis first took place, and rendered the dishing of the spokes necessary to gain room and stability to the carriage, and strength to the wheels: and if dished wheels were applied to a straight axle, the spokes would not stand upright under the axle, as Mr. Walker has supposed.

20. And thus it appears, that the *dishing* could not have preceded the bending of the axis; nor have dished wheels hitherto ever accompanied the straight axis, nor the upright wheel the bended axis; which is a further proof that the *dished wheel* is congenial to the *bended axis*, and was occasioned by it.

21. And it appears from every circumstance that has been mentioned, that the

bending of the axis, was rendered necessary by the narrowness and deepness of the ancient roads, and rendered practicable by the new system of making the wheel to turn on the ends of the axis; and this bending of the axis introduced the splaying of the wheels (7), the dishing of the spokes, and the conical rim.

22. And it appears very probable, that the bending of the axis and the splaying of the wheels, were in use for years, before the dishing of the wheels was thought of.

23. In Appendix A, to the first Report of the Committee, in June 1808, page 58, Mr. Ward says, "that about 40 years since, convex roads were general; and the roads being convex, it was necessary that there should be a curvature of the axil, *to bring the sole of the wheel upon the road.*"

24. By which expression, it is presumed is to be understood, that "by this bending of the axis, the rims of the pair of wheels would be brought to the most favourable position, and to the most equal bearing of their whole breadth on the convex surface."—And as no convexity of the road can account for that quantity of bending of the axis, which we daily see with the broad-wheeled waggons, it becomes necessary to investigate this matter more closely, and to compare the degree of bending, which can be occasioned by the convexity of the road, with the degree of bending which we may daily see with the broad conical wheels.

25. We are then to enquire what proportion the bending of the axis required, to adapt the wheels on its ends to a given convexity of the road, would have to the bending of the axis of one of our conical 16-inch waggon wheels? And here it is to be observed, that the angular measure of the splay, of the dishing, or the obliquity of the spokes, and the taper of the conical rim, do each depend on the quantity of bend of the axle, and are each equal to it.

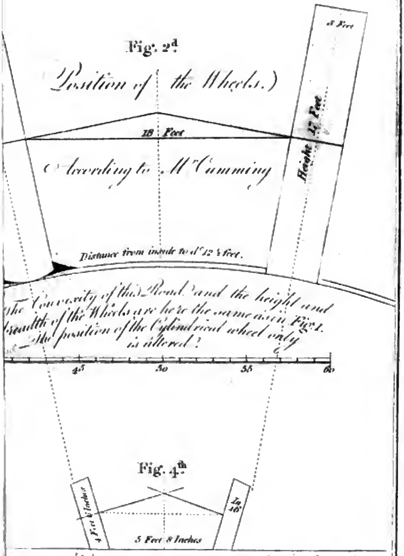
26. It has in a former part been stated, that the bending of the axles was introduced at an early period, when the roads were very narrow and deep, in order to *splay* the wheels, and to gain room to the body of the carriage; and laws having been since that time enacted, to limit the greatest distance at which waggon wheels are allowed to roll, on account of the weigh-bridges; and the carrier being unconscious of the bad consequence of the bended axis, to his cattle, and to the roads, by introducing the conical rim, he yet continues the bended axis, and the splay of the wheels, little thinking that this bending of the axis, unavoidably renders the rims *conical*, (to gain an equal bearing on their whole breadth) and intro-

Plate II

...d. Axle ?

Fig. 2d

(Position of the Wheels.)



A pair of Conical wheels shewing the Bend of the Axle
that is necessary to give the Rims an equal bearing on a
Flat Surface, & And if the Road had been Convex the
bend must have been greater in proportion to the convexity.

Basire sc. 235 Strand.

duces the long train of evils that have been stated,* in the Report of July 18th, 1806. And in a former Communication by Mr. Cumming to the Board of Agriculture, published in the Second Volume of Communications, 1799.

27. The legal restriction as to the distance of carriage wheels, is continued, in order that they may roll within the breadth of the weigh-bridges; but that restriction, together with the authority of *ancient uninterrupted usage*, will probably be sufficient to continue the use of the bended axis, until the salutary effects of the new regulations, and the disadvantages of the conical rim are more attended to, and better understood.

28. And here, while I express my admiration of the patient perseverance, judgment, and attention, that have been bestowed by the Committee, on the investigation of this subject, I cannot help regretting, that the necessary attention to the numberless interests and various opinions that are concerned in opposing any innovation, necessarily renders the progress of legislation so difficult and slow, that the good effects that may reasonably be expected, in the present instance are not only retarded, but will become less beneficial, and less sensibly felt, by the gradual slow manner in which the improvements are adopted.

29. The circumstance of the bended axis, is of much greater importance than it is generally thought to be, on account of its introducing the conical rim: and from that circumstance may be drawn a further argument for asserting, that the *convexity of the road* could never have originally occasioned that curvature of the axis, which has introduced the conical rim: that curvature of the axis, which is occasioned by the convexity of the road, *does not demand a conical rim*;† the cylindrical wheel requiring much less splay of the wheel for any given convexity of the road, than a conical wheel would require: it therefore follows, *that cylindrical wheels are much easier adjusted to a convex road, than conical wheels:* and wheels that are rounded on the sole, can never have a flat or proper bearing, on its whole breadth on any road, whether flat, convex, or concave.

30. Moreover, although a great convexity of the road, may furnish reason for a very small bend of the axis, that bend has no tendency to introduce a conical rim: nor would that bending of the axis which might be required from the convexity of

* See Cumming's Essay on broad wheels, page 11, where the properties are enumerated, which are peculiar to the *conical shape*, and *inseparable from it.*

† See Fig. 5. Plate I. and Fig. 3, Plate II.

the road, ever amount to one fourth of the bend that is now universally used to the *broad wheeled waggons*, if their wheels were cylindrical, instead of conical.* Here then we discover a *criterion* by which to determine, whether, the bending of the axis was first occasioned by the convexity of the road, or by some other cause. If the bending was occasioned by the convexity of the road, the wheels would yet be cylindrical. If by the narrowness of the roads, the wheels must be conical to give the rims a flat bearing. And this circumstance, appears finally to decide the question; and to prove that the bending of the axle was not originally occasioned by the convexity of the roads, and that the cause which originally made the bending of the axle necessary, does not at this time exist; all public roads bneig of sufficient width for any carriage without bending the axles.

31. It might here be asked of those who are of opinion that the bending of the axis was not originally occasioned by the narrowness of the roads, how it has happened that wheels became *conical?* For, the cylindrical rim is much more adapted to the convex road, than the conical rim; and would require much less bending of the axis for the same convexity of the road; or, why were the spokes put obliquely into the nave, unless the axis were bent? Many more questions might occur that have a direct tendency to demonstrate, that the original bending of the axis, must have been occasioned by the narrowness of the roads; not by the convexity. And it seems more than probable, that the bended axles were used, long before convex roads were thought of, that convexity being rather a modern improvement.

32. But it may be questioned, what practical advantage can be gained by deciding, to which of several causes the bending of the axle is originally to be imputed, provided the bending is proved to be unfavourable in practice?—There is a degree of respectful reverence due to the wisdom of our ancestors, and to the experience and the uninterrupted usage of ages, which ought neither to be treated lightly, nor allowed to obstruct the progress of improvement: And in the present instance, it is of much importance in removing prejudice to shew that the cause which in former times rendered the bending of the axis necessary, no longer exists in our public roads; and that bending the axis may now be discontinued, and the straight axles universally adopted: without even the shadow of disrespect to the judgment of our predecessors; and the straight axis will necessarily be accompanied by the cylindrical wheel, with all the advantages that have been

* Compare the third Diagram with the fourth, in Plate II.

proved to be peculiar to that superior form:* and by that means, we not only gain all the advantages that are peculiar to the cylinder, but we likewise avoid all the evils that attend the conical rim, by abandoning the bended axle.

33. But it has been admitted, that a convex road might in a strict mathematical sense, require a very small bend of the axis to bring the sole of a pair of cylindrical wheels, to their flatest bearing on the convex surface: but this bend must be so very limited with the greatest convexity of a road, now in use, as not to be very perceptible in practice; for the difference between a straight line of 7 or 8 feet long, and the same length, of the circumference of a circle of 80 or 90 feet radius, is scarcely perceptible to the eye, and deserves but little attention in practice, whether the road be flat, or of moderate convexity.

34. This will appear more evident, by contemplating the Diagram, No. 5. Plate I. in which the convexity of the road is to a radius of 60 feet only; its breadth 20 feet; the distance of the wheel from center to center 7 feet; the height of wheels $4\frac{1}{2}$ feet; their breadth 16 inches: the axle is represented by two lines intersecting each other at the middle of the space between the wheels, and shewing the quantity of bend that is requisite to bring the sole of the *cylindrical broad wheels,* to *the most advantageous* bearing on that convex surface. And although, considered in mathematical correctness, there is a difference between that part of the convex surface that is covered by the wheel, and a straight line of the same length, it would be absurd to make any such distinction in practice; as the difference between a length of 16 inches of the circumference of that circle, and a straight line, is in a case of this nature, totally unworthy of notice; the compressibility and elasticity of the hardest roads, would allow the whole breadth of the cylindrical wheel to come into as equal contact with the convex surface, in this case, as if the road were perfectly flat.

35. By this enquiry into the original cause of bending the axles of wheel carriages, we learn, that when the roads were very narrow and deep, and the axles extended from "bank to bank," there was great difficulty in gaining sufficient room for the carriage without widening the roads in very many places: and the

* See the account of the experiments exhibited by Mr. Cumming, before the Committees of the House of Commons, in their second Report, pages, 5, 6, and 7; and in the Appendix to that Report, from page 5 to 22. And likewise in the Communications to the Board of Agriculture for the year 1799, the 2nd Vol. of Communications.

improvement of the roads requiring the concurent aid of so many parties, became a hopeless relief at that time; and the smallness of carriages rendering them inadequate to the purposes of commerce, the expedient of bending the axis, and splaying the wheels, to gain room to the body of the carriage was thought of; but considerable difficulties occurred in accomplishing that improvement; the wheels of all such carriages were at that time fixed on the ends of the axle, and it turned with them; consequently the axis was always straight, and the wheels parallel to each other; See Fig. 1. Plate I. And this old system must be totally altered, before the bending of the axis, or the splaying of the wheels could take place.

36. Splaying the wheels required a bending of the axle; and here, new difficulties occurred. This bending of the axis brought the wheels so near together on the ground, that the carriage must be extremely liable to overset. See Fig. 2. And to remedy this inconveniency, without losing room above the axis, required considerable ingenuity; but it was effected, by inserting the spokes into the nave in such an oblique manner, that each spoke should stand *upright* when it came immediately below the axis; and this oblique position of the spokes in the nave of the wheel extended the base, gave stability to the carriage, and added as much to the room of the body, above the axis, as it did to the extent of the base below it. See Fig. 3.

37. And thus did our progenitors, wisely and ingeniously adapt their carriages to the existing state of their roads. By bending the axis, they gained an immediate advantage of enlarging the carriage; without which expedient, they must have been deprived of that advantage until a general reformation of the roads took place: and although the bending of the axis is at this time known to require a conical wheel, the narrowness of the wheels that were then used, made the distinction between the conical shape, and the cylindrical, at that time of no importance.

38. But now that all public roads are made of a sufficient width to admit of carriages of any breadth, there is no longer occasion for bended axles; and as the advantages of a broad bearing of the wheels is so obvious, and the contrary effects of conical, and of cylindrical rims, are now so well understood, and as it is known that the breadth of cylindrical wheels may be increased without that increase of resistance which has been found to take place with broad conical wheels; and has given all persons concerned in the use of broad wheel carriages, a dislike to all broad wheels without distinction, not knowing, that the resistance of which

they so justly complained, was occasioned by the conical shape of the wheel, though imputed to its breadth; nor, that the conical wheels which they had always used, were equally unfavourable to the roads, and to the cattle; nor were they aware that wheels of the same breadth of a cylindrical form, would be as favourable to the preservation and improvement of the roads, and to the labour of the cattle, as the conical were disadvantageous to both. The narrowness of the roads, gave occasion to bend the axle; and the bending of the axis, occasioned the conical rim, with all the train of unobserved evils which belong to that shape; nor can those evils be avoided, nor the manifold advantages which belong to the cylindrical shape, be gained, so long as the bended axles are used.

39. And since the bended axis necessarily requires a conical rim, all the evils which are inseparable from that rim, may justly be imputed to the bended axis; and by abandoning the former we get rid of the latter; and by adopting the straight axis we necessarily have the cylindrical rim, with all the advantages that are peculiar to that shape.

40. To which advantages may yet be added; that, by discontinuing the use of bended axles, all the disadvantages that arise from the want of an equal and proper adjustment of the bendings of both ends of the axis, that is so necessary to secure the harmony of action of the wheels on its opposite ends, will be totally avoided by finishing both ends of the straight axis in the lathe, which will leave both ends in the most favourable position possible, for giving to the wheels on its opposite ends the most perfect unison of action in their progress, which they very seldom have when the axis is bent, unless under the management of a very judicious manufacturer; and much power is frequently wasted from that defect only.*

* In page 93 of the Appendix to the Report of May and June 1808, Query 24, "The reason the Falkirk carters give for preferring a wooden axle to an iron one?" Answer—"Owing to the hilly ground, and rough roads, but chiefly to hilly grounds.

Here it is stated by Mr. Stainton, that iron axles have frequently been tried and found to injure the horses backs: "they were immediately galled when iron axles were used."—This effect has been imputed to the want of elasticity in the iron axle.—Mr. Cumming is of opinion that galling of the horses backs was owing to a constant reciprocal jerking of the chain which supports the shafts across the horses back: if either end of the axle should have any tendency to make the wheel to converge, diverge, or any how to deviate from the direct line of progress; a constant tremulous motion will commence at the rim of the wheel, and be communicated by the shafts to the chain across the horses back, shifting constantly and quickly from side to side, which must very soon gall the horses back.

41. Thus we see, that although the narrowness of the roads in their primitive state, made it necessary to bend the axle, in order to gain room for the body of the carriage, the present state of the public roads, gives sufficient room for the largest waggon, for every purpose of commerce, without any occasion for bending the axis; and thus we are no longer under that necessity which obliged our predecessors to use the bent axle.

42. We are now at full liberty to use the straight axle without the necessity of contracting the room of the carriage; and by rejecting the bended axis we are enabled to use cylindrical wheels of any breadth, without introducing any part of that resistance of which the waggoners had such just reason to complain with the conical broad wheels; and their complaints against the flat bearing of broad wheels, furnishes the best evidence of the great importance of discontinuing the use of the *conical rim*, and adopting the cylindrical.

43. Since the improvement of our public roads, now admit of carriages of any breadth; and the improved state of our commerce imperiously demands immense loads, the only means by which our roads can be preserved, is by making the wheels of a breadth proportioned to the weight of those loads; or, to the number of horses that draw them; which may now be done to great advantage by rejecting the bended axis and the conical wheel.

Here it may be asked, why the same thing does not happen with wooden axles? It must be confessed that a satisfactory answer to that question is not easily given; but experience, and a due attention to all the circumstances attending the practice, will soon prove whether the idea be well founded, or not.

Mr. Cumming's opinion is, that the superiority of wooden axles, to the iron, in this respect, is owing more to the means, and methods by which both ends of the wooden axles are formed, and set off from given straight lines, than to the nature of the different materials: the joiner or wheelwright, forms the timber of which the axletree is to be made into a perfect, straight square piece of timber, and from the external lines, sets off the direction of both ends of the axle exactly similar to each other: but in forming the iron axis, and more especially in bending its ends downwards, they have no such rule of direction, nor are they aware of the mischievous effects of any difference of the bends of both ends of the axis; or of any tendency of the wheels of either end to deviate from the true line of progress, which knowledge is absolutely necessary to produce a sound steady progressive motion, free from that tremulation which is much easier conceived than expressed, and which is here supposed to have galled the horses backs in the instance alluded to; but by pursuing proper methods of adjusting the bend at both ends of the iron axle, there can be little doubt of preventing the evil complained of.

44. But now that broad wheels have come into use, the distinction between the *straight*, and the *bended axles*, is of the greatest importance. In order to give the wheel an equal bearing on a flat surface, the *straight axis* demands a *cylindrical rim*, and the *bended axis* a *conical rim*; hence, the distinction between the bended axle and the straight, is as important as that between the conical and the cylindrical rim.

45. But as the distinction between the conical and the cylindrical rims was of no importance while narrow wheels only were in use; the different effects of the straight, and of the bended axles, were also unattended to; and as the latter, had in its favour the sanction of long usage, it has been continued without much enquiry into its effects or consequences, for many years *after the introduction of broad wheels*; and after the owners of broad wheel carriages, and all concerned in the management of them, had for very many years loudly complained of the increased resistance to the progress of their waggons with broad wheels *having an equal bearing on their whole breadth*; but it was little suspected that this increased resistance originated wholly from the bending of the axis.

46. And when it is considered that bending the axle, has introduced the conical wheel with all its concomitant evils, and prevented the adoption of the cylindrical wheels with all their advantages; it cannot be denied that it is of much importance to ascertain the true cause that first recommended the bend of the axis; to trace the several consequences that have attended it in the progresssive improvement of carriage wheels; and to show, that although it was necessary in the original state of the roads; its continuation, *since the introduction of broad wheels*, has occasioned a national disadvantage of many millions yearly, by favouring the use of conical wheels in opposition to cylindrical.

47. If those few observations on the probable cause that first occasioned the bending the ends of the axles downwards, and on the gradual change of circumstances, which at this time render a contrary practice necessary, should remove the scruples of those who venerate the wisdom of our ancestors and the authority of long usage, and induce them to embrace cordially, the important improvements which at this moment engage the serious deliberation of the legislature for the publick good, the object in thus offering them to notice is fully obtained, and it is hoped that the ultimate importance of the subject, may be considered as a sufficient apology for dwelling so long on a matter, which at first sight might appear of so small moment.

Cursory Remarks by Mr. CUMMING, *on some Observations of Mr.* WARD, *in the Appendix to the First Report of the Committee on the Highways of the Kingdom. Printed May* 11th, 1808. *See page* 114.

THE observations of Mr. Ward, appear to Mr. Cumming, as calculated to support the opinion, that cylindrical broad wheels, are less adapted to convex roads, than conical wheels, and ultimately leading to the conclusion, "that it is more ad-" vantageous to have the sole of broad wheels convex, than truly cylindrical."

1. Mr. Ward says, that "*conical wheels* placed upon bent axletrees, certainly " constitute portions of a curve, corresponding to the barrelled form of the road;" and *therefore*, " their pressure will always be the same;" " but the resistance oc-" casioned by the increased friction, proved by the experiments of Mr. Cumming, " is so great, as to demand complete alteration."—" But that friction and conse-" quent destruction of the road, is not so great as Mr. Cumming has inferred;" " instead of being regular segments of lines, they are all rounded, and only press " upon the road with the center tire iron;" " to the breadth of which, the injury " is confined."

2. " Perpendicular wheels, with straight axletrees, will assuredly run with the " least possible friction, *but their bearing upon barrelled roads, must be confined to* " *their inner edges.*" " *Therefore*, the breadth which Mr. Cumming proposes will " be superfluous," " unless the road be crushed down by the inner edges, suffi-" cient to give a full bearing to the wheel, and then as much injury will be done " to the roads, as by the conical wheel." " See Plate V. Diagrams 6 and 7," by Mr. Ward.

3. As full remarks on all that is contained in these two paragraphs would occupy very many pages, Mr. Cumming confines himself to what regards the Diagrams 6, and 7, only, as that does pretty well show Mr. Ward's meaning, and his disposition towards the cylindrical wheel; and Mr. Cumming wishes to engage as little of the time or attention of the reader as is consistent with perspicuity.

4. The two Wheels, Plate I. fig. 6, and 7, represent a conical and a cylindrical broad wheel, applied to the surface of a convex road, according to Mr. Ward; by whom, the cylindrical wheel is represented as resting on its inner edge, and in a position well calculated for cutting the road destructively.

5. But Mr. Cumming apprehends that no fair conclusion can be drawn as to the merits of the different wheels, unless both are placed in all respects, in circumstances equally favourable to both; but the circumstances under which the conical and the cylindrical wheels are here placed, are very dissimilar, and all disadvantageous to the cylindrical wheel.

6. As Mr. Ward has annexed no *scale* to his diagram, by which the proportion which the several parts bear to each other, and to the breadth and convexity of the road can be known, it therefore becomes necessary to establish a scale or common measure, by means of which the several proportions may be ascertained.

7. Let a right line be drawn, joining both ends of the circular arc that represents the convex surface of the road; find the center of that arc; and from that center, draw a right line bisecting the arc; and supposing the road to be 40 feet wide, let that breadth be divided into 40 equal parts, and this will become a *scale* of feet, and a common measure of all the parts of the diagram; and from the center likewise, draw right lines to the middle point of each wheel on the surface of the road, and these dotted lines will give the proper *splay* of the wheels for the convexity of the road, and the proper position in which the wheels ought to stand. See Plate. II. Fig. 2.

8. And by means of a *scale* thus constructed, it appears that the radius to which the convexity of the road is formed, is only 42 feet; the breadth of the road being 40 feet; length of the axis of the cylindrical wheel, according to its distance from the central line is 18 feet; height of the wheels 16 feet; breadth of the cylindrical wheel 3 feet and a half, or 42 inches.

9. The object of this investigation is, to discover how far the rims of true cylindrical wheels 16 inches broad, may be made to apply their whole breadth, flatly to the surface of a road having such a degree of convexity, as would be necessary to make the water drain to both sides.

10. It has been found by experience, and admitted by men of accurate observation, that a declivity of *one inch in 4 feet*, that is one in 48, is sufficient to carry off the water: let us then compare that declivity, with the declivity in the diagram of Mr. Ward.

11. According to the *scale*, the middle of the road is 5 feet higher than the sides, and this would give a declivity of 60 inches on each side; which is more than *ten times* as much declivity, as is sufficient; and this shows that the convexity of the

road, as represented in Mr. Ward's diagram, is *by much too great:* the rise in the middle of this road, ought to be no more than 6 or 8 inches at the most, instead of 60.

12. The *breadth* of the cylindrical wheel in Mr. Ward's diagram is 42 inches, although the greatest breadth in use is only 16 inches; and this greatly magnifies the apparent difference between the flat sole of the cylindrical wheel, and the barrelled surface of the road.

13. The length of the axis of the cylindrical wheel, (by the distance of the wheel from the central line of the road), is 19 feet; though it ought to be no more than 6 feet: and this throws the cylindrical wheel on a part of the road more distant from the middle than it ought to be, and where the slope or declivity is much greater; and this tends greatly to throw the bearing on the inner edge of the wheel in the diagram, more than it ought; and adds very much to the unfavourable appearance of the cylindrical wheel, as represented by Mr. Ward.

14. But most of all, the very unfavourable position in which the cylindrical wheel in the diagram is placed, (7) gives a very unfair and unfavourable impression of its effects on a convex road; and it seems rather surprising, that the same mistake has not happened in the position of the round bottomed conical wheel, in the same diagram: (6) which is put in the true position in which the cylindrical wheel ought likewise to have been placed on the convex surface: which true position is here represented by a dotted line pointing to the center of the circle which forms the convexity of the road. See Plate II. Fig. 1.

15. Mr. Cumming has here given (for the satisfaction of those who are not possessed of the Report of the Committee, in which is the original), an exact copy of Mr. Ward's diagram, adding a few explanatory dotted lines, and a scale by which the proportion of the several parts may be ascertained. And by comparing the observations which have already been offered, with this diagram, the reader will be enabled to judge how far Mr. Ward's is a fair representation of the state of the cylindrical wheel on a convex road.

16. In a second diagram, in the same plate, Mr. Cumming represents the same wheels, on the same convex road, altering only the position of the cylindrical wheel, to what it ought to be in practice; and although the convexity of the road in this diagram gives a declivity of 5 feet towards each side, which according to the best authorities, ought to be no more than 8 inches, and notwithstanding the breadth of

this wheel with which Mr. Ward has favoured us, is 42 inches, and the wheels are distant from each other on the surface upwards of 12 feet; the flat cylindrical rim does not, in that great breadth, and under those many disadvantages, deviate sensibly from a flat bearing on this very convex surface of the road.

17. In the two preceding diagrams, Mr. Cumming has continued that great breadth of wheel, and great convexity of the road, which Mr. Ward has thought proper to represent in his original scheme; in order to show, that by placing the wheel in its proper position only, the flat cylindrical rim applies so well to the convex surface of the road, that to use the expressive language of Mr. Russell, "they meet face to face," notwithstanding the extravagant breadth of the wheel, the great convexity of the road, and the extraordinary length of the axle.*

18. How small then must the deviation of the cylindrical rim of a sixteen-inch wheel be, when placed in its proper position, on an axis of a proper length, and on a road of due convexity, may be seen by the diagram Plate I. Fig 5. where every part is drawn to its due proportion: the convexity of the road to a radius of 60 feet only; its breadth 24 feet; breadth of the wheel, 16 inches; their height 4 feet 6 inches; length of the axis from inside to inside of the naves, 5 feet.†

19. In this diagram, in which the true proportion of every part is preserved,

* That Mr. Cumming is not singular in his opinion of Mr. Ward's diagram, appears by the observations of Mr. Boswell, in page 84, Appendix (B) Report, 19th June, 1809, where Mr. Boswell says, "In most roads, no perceptible variation from flatness will be found in the extent "of the axles of waggon wheels: some few badly shaped roads may occur where this inconve-"niency would take place, but none where it would happen in any degree similar to that represent-"ed in the diagram of Mr. Ward, Plate V. of the Report, which, from *its neglect of proportion, is* "*calculated to mislead public opinion, on an important point.*" &c. &c.

And Mr. Orr, in the additional Appendix to the same Report, page 132, writes as follows.

"Mr. Ward says, perpendicular wheels, with straight axletrees, will assuredly run with the least "possible friction, and give a broader support to the carriage;"—"but their bearing on barrelled "roads must be confined to their inner edges;"—"therefore, the breadth which Mr. Cumming "proposes will be superfluous, &c."—"And he refers to his diagrams and figures." "I do not "(says Mr. Orr) think his diagram gives a fair representation of either the roads, or the perpen-"dicular wheel; the segment of the circle which represents the convexity of the road, is by far "too convex;"—"as round as the segment of a sugar hogshead." &c. &c.

† This diagram was several times produced to the Committee by Mr. Cumming, to show how easy it was to adapt cylindrical wheels to a convex road, by a very small bend of the axle, and there is no reason to suppose, that any thing which passed there was unknown to Mr. Ward.

due regard is paid that the splay of the wheels is duly adapted to the curvature of the road, that being to a radius of 60 feet only: and from the splay of the wheels, the bend of the axis is found, that shall give to the sole of both the cylindrical wheels, the most favourable bearing possible on the convex surface; and this bend of the axle in the present case is so trivial as scarcely to challenge notice.*

20. How little inconveniency, or damage, is then to be apprehended, with wheels only 16 inches broad, on a convexity of 80 or 100 feet radius?

21. The diagram Fig. 5. Plate I. represents a pair of cylindrical 16-inch wheels adapted to the convexity of 60 feet radius, and drawn to their due proportion according to that radius: the lines which are drawn from the center of the convex surface through the middle of each wheel, give the true splay of the wheels for that convexity of the road; and the splay of the wheels gives the bend of the axis, that is necessary to bring the sole of the wheels to the proper bearing on that convex surface; and although the convexity even in this figure is considerably greater than is allowed in practice, the cylindrical wheels have the most advantageous bearing possible; and the bend of the axis that is required to give to the cylindrical wheels this advantageous bearing on the convex road, is incomparably less than the bend of axles that are commonly used even on flat roads, with conical broad wheels: how then can "*conical wheels placed upon bent axles*" be said to "*constitute*" *portions of a curve, corresponding to the curvature of the road?*

22. It may be observed in this diagram, that there is no sensible difference between the bearing of the wheels on this convex surface, or on a flat surface; and so far are the inner corners of the wheels from cutting the road, (as Mr. Ward has asserted they must,) that the middle of the rim is the first part that touches the surface, and that sustains the greatest pressure; but even this difference exists only in theory; there being in practice, no sensible difference between the bearing of the cylindrical wheels on a surface of this convexity, and its bearing on a surface that is perfectly flat.

23. In Plate II. Fig. 3. a pair of cylindrical wheels are adapted to the very same convex surface which Mr. Ward has assumed in his diagram, in which the convexity is to a radius of 40 feet only; although the general convexity of the roads, is to

* Let this diagram be compared with Mr. Ward's (fig. 7), and the difference will show how far his representation is correct.

a radius of from 80 to 100. And here we see what a very small bending of the axle brings the cylindrical wheels to the most advantageous bearing possible, even on this very convex surface; how then can it be asserted that the inner corners of the cylindrical wheels must cut the road, if the wheel be properly applied?

24. Mr. Ward says, "that conical wheels upon a bent axletree certainly con- "stitute a portion of a curve corresponding to the barrelled form of the road; and "therefore, their pressure will always be the same."

25. It were to be wished, that Mr. Ward had here been more explicit; but Mr. Cumming supposes that it is intended to intimate that the conical rims are better adapted to the convex form of the road, than cylindrical rims; but Mr. Cumming being of a contrary opinion, refers the reader to Fig. 4. Plate II. which represents a pair of 16-inch conical wheels, rolling on a flat surface, and drawn to the same scale as the cylindrical wheels in Fig. 3. And the bend of the axles in both diagrams being adjusted by the splay of the wheels, that is, the ends of the axles being set at right angles to the plane of the wheels, the bend of the axle is out of all proportion greater with the conical wheel on a flat road, than with the cylindrical wheel on the convex road; and the bend of the axis must have been yet greater with the conical wheels, if the surface on which they roll had been convex.

26. It may be necessary here to mention, that the splay of the conical wheels in Fig. 4. is taken by actual measurement from one of the Kidderminster broad-wheel waggons, when unloaded. And it may easily be conceived, how badly those conical wheels would apply to a convex surface with the same bend of the axis that is necessary with the cylindrical wheels; and how much worse than the cylindrical wheels, the conical would apply to the convex road, if the axles of both were straight, or equally bended?

27. How then does it appear, "that conical wheels, placed upon bent axletrees, "constitute portions of a curve corresponding to the barrelled form of the road?" It must be left to Mr. Ward to solve this paradox: for it appears to Mr. Cumming, after viewing the subject in all its points and bearings, that the cylindrical wheels, under proper management, are as superior to the conical, on convex roads, as on those that are flat; and that the inner corners of the cylindrical wheel, with the same bending of the axis, have much less tendency to cut the road than the conical wheel, with the same bend of their axles.

28. And although some roads may be formed so very convex, that a small bending

of the axis might not be disadvantageous to give cylindrical wheels the most favourable bearing on their surface, Mr. Cumming is of opinion, that no roads are now made so much barrelled as to require in practice *any bending of the axis*, with the cylindrical wheels, more than if the road were flat.

29. From some observations of Mr. Ward's, in page 115 of the Appendix to the first Report, of May and June, 1808, he appears to Mr. C. to depreciate the cylindrical wheel, to make way for the rounded sole; his observations are thus introduced:

30. " In respect to the breadth of wheels, the weight bearing upon four points, " if the wheel is narrow, it will cut deep into the road; *if it is broad*, there will " be a great additional weight *without an increase of bearing*, unless the road " gives way."*

31. " The inconveniences of these extremes (says Mr. Ward) point out the " medium as the most beneficial. The narrow wheels should be widened from two " inches to four and six, according to the weight, and the broad wheels diminished " six and eight."

32. " If their rims are flat, their pressure will be confined to the part of the " road they run upon; but frequently they must press, or rather cut with their " inner edges. If they are rounded, they will act like a wedge, with lateral pres- " sure, and break the cohesion of the roads upon the sides of the track. *A small " convexity, therefore, just sufficient to bring the center of the rim in all cases in " contact with the road, appears to constitute the best form.*"—The convexity of the road alone, is more than sufficient for this purpose.

33. But according to Mr. Ward's own principles, (so far as they can be collected in those sentences,) he appears to admit, that the first requisite towards perfection, is, " that the middle of the wheel, or the center of the rim, should come in " contact with the road; and this being done, that the more equal the bearing of " the wheel, the more perpendicular and compressive is its action on the surface, " and the less is that lateral action, which breaks and deranges the materials on both " sides of the track."

34. All which advantages are more completely obtained with the cylindrical wheel on the convex road, as before stated (22), than can possibly be done by

* This is certainly true as applicable to the rounded sole; but in no degree to the true cylindrical wheel, if judiciously applied.

rounding the sole of the wheels on a road of any possible form. And all the advantages of the cylindrical wheels are as superior to the conical, on roads of a moderate convexity as on those that are perfectly flat; and by a very small bend in the middle of the axle, cylindrical wheels may be adjusted to a road of any convexity, so as to have the most advantageous bearing on the convex surface that can be conceived, or wished for: and the middle of the cylindrical rim shall have the greatest bearing on the convex surface in as much as the flat sole of the wheel differs from its breadth of the convex surface.

35. How then can it be maintained, " That the bearings of cylindrical wheels on " convex roads must be confined to their inner edges?" " And that on convex " roads the cylindrical wheel, by the crushing down of its inner edges, will do as " much damage to the road, as the conical wheels?"

Mr. Cumming cannot suppress his expression of surprise that opinions and arguments so unfavourable to the adoption of the cylindrical wheel, and so adverse to the declared opinion of *two Committees of the House of Commons,* and to the almost unanimous opinion of those to whom the printed copies of the evidences were transmitted by the Committee, should thus be laid before the public, at a time when they were most likely to create opposition, by confirming former prejudices against broad wheels, and by recommending a deviation from the true cylindrical shape; and that, by a gentleman who, under the auspices of the Committee, was preparing a systematic compilation of all the evidence and information that was gained by them, in four successive sessions of Parliament, and whose opinion, under those circumstances, might have very great weight with the public. It were therefore to be wished, that Mr. Ward had formed a more decided manner of giving his opinion, or that he had offered none, as the undecisive manner which he adopts, has perhaps a greater tendency to create, than to remove doubt; and to confirm prejudice, rather than to give birth to fair investigation. But perhaps Mr. Ward is not fully understood; if so, Mr. Cumming will not be backward in acknowledging the weight of any new arguments which he may adduce, in support of the opinions which he has offered.

36. Thus far, Mr. Cumming supposes that the opinion of Mr. Ward is repugnant in severeal instances to the opinion of the two Committees of the Honourable the House of Commons, delivered in page 3, of their Report of 11th May, 1808, where, under the head, WHEELS, they say,

37. " This is a point which has been very fully discussed in a Report already " before the House, to which your Committee beg leave to refer." " In that Re- " port, the superiority of the cylindrical form of wheels was fully explained; and " from the additional evidence which has been laid before them, your Committee " can entertain no doubt of the infinite superiority of the cylindrical shape, with " respect to ease of draught, and the preservation and improvement of the roads."

38. All the inherent properties of the cylindrical wheel have been considered separately, as they affect the roads, and the labour of cattle, and demonstrated from theory, proved by experiment; approved by two Select Committees of the House of Commons, and unanimously by those to whom copies of the Reports were sent by the Committees, in order to collect their opinions; and confirmed by three years experience, under the management of an able and judicious civil engineer.* Nevertheless, a gentleman who writes under the auspices of these Committees, has offered an opinion adverse to theirs, unfavourable to the adoption of the cylindrical principle, and in favour of the convex or rounded sole, under circumstances that must give weight to his opinion, in directing the public choice.

39. It is but justice, however, to Mr. Ward to state, that two very respectable members of the Committee, and almost all the carriers, were in favour of a convex sole; and that in the Report of the 11th May, 1808, the Committee make the following observation, page 4:—

" On the subject of cylindrical wheels, it has been much disputed, whether they " ought to be a complete cylinder, or a little rounded at the edge;" but the Committee were of opinion, " that as any deviation, however inconsiderable, is so apt " to justify greater evasions, that it was expedient to enforce a shape strictly " cylindrical."

40. Mr. Cumming having already far exceeded the intended length of his observations in reply to Mr. Ward, (so far only as regards the application of cylindrical wheels to convex roads,) proposes to conclude with an observation or two on the general effects of the true cylindrical wheels, and to show, how very contrary are these effects, to those of the convex rim, on the external appearance and the general state of the roads.

41. It has already been proved that the true cylindrical wheel advances with a dead pressure, having no dragging at its rim, and no tendency to derange or

* Mr. Jessop.

displace the materials over which it rolls; and Mr. Ward will probably not deny that the cylindrical is the only shape, that has no tendency to alter the relative position of the particles on which it rolls in any other manner than by compression; nor that the effect of compression, by bringing the parts into a more perfect contact, and more within the sphere of mutual attraction and cohesion, and more impervious to water, promotes progressive induration while the materials remain undisturbed and unbroken; nor can it be denied that the true cylindrical shape is the only form of a broad wheel, which having an equal flat bearing on its whole breadth, has no tendency to break or alter that arrangement of the materials, on which it rolls, from what it finds them; the materials therefore on which cylindrical wheels only roll, remain compressed, unbroken, and undisturbed by that repeated pressure and rolling.

42. Every cylindrical wheel, that rolls in the track of another, will apply its whole breadth to the bottom of the former track as flatly as the wheel that formed it; nor will the second wheel have any tendency to loosen or disturb the materials; but on the contrary, to consolidate and unite with the general mass, any loose particles which may have come under its pressure. And thus all cylindrical wheels, reciprocally rolling in the tracks of each other, will apply the whole breadth of their rims flatly, the one to the track of the other, without any tendency to disturb the materials, or to obstruct the induration, but on the contrary to consolidate more and more, every time of rolling; and the cylindrical is the only shape of a rim that can have those advantages.

43. And whoever has noticed the effects of compression and induration on materials of old roads that have lain some years undisturbed, will know how to prize those properties of the cylindrical wheels, that are so favourable to consolidation and induration, and that are peculiar to that shape alone. There are two general properties peculiar to the cylindrical wheel, in this respect: all cylindrical wheels apply flatly to the tracks of each other, and all their pressure tends to consolidation, without lateral pressure, or any tendency to break the texture of the materials on which they roll, after the track has been once formed.

44. But if wheels are made convex, or rounded on the sole, they no longer have the properties of the cylinder; on hard roads, convex wheels bear only on a narrow part of their rim; and the intensity of the pressure is greater, as the bearing of the wheel is narrower; and if the surface of the roads yields to

the pressure of the wheel, it acts laterally more or less according to the convexity, or rotundity of the rim; and this lateral action tends to disturb and break the materials on which they roll, and to prevent cohesion and induration: and moreover, they form the surface of the road into flutes, which prevent the water from draining down the sides of the convex road; and the materials that are forced out of the flutes or tracks of the rounded sole, form a ridge or protuberance on each bank or side of the flute, which prevents the water gaining admission into the track, and it is thus detained on the surface, and mixing with the loose materials, forms sludge; and the pernicious effects of sludge on the road, are too well known to require further explanation.

45. The surface of the road thus fluted, is formed into sharp ridges, easily broken, crushed, and formed into dust or sludge; and the constant change of position of the parts leaves no chance of permanent cohesion, or induration; every time the convex wheel passes, it not only forms the surface into flutes, but the pressure of the round bottom acts laterally on the material on both sides, and opens chinks or small fissures or cracks, which admit the water into the gravel or other materials thus prepared for its reception.

46. And thus the faculties of reasoning and due attention to minute effects may assist in discovering cases which may be concealed from sight from a variety of circumstances; the knowledge of which may nevertheless be essentially necessary to the attainment of practical improvement and perfection; the national advantages which might have been enjoyed by the public from the use of cylindrical wheels, has for very many years been lost from the want of due attention to the true cause that first occasioned the bending of the axles: had the bending been imputed to the true cause (the narrowness of the roads) straight axles would probably have been adopted, so soon as roads were made wide enough to admit carriages of a proper size, without splaying the wheels; (or bending the axis;) but the bending of the axles being imputed to conjectural causes, the real cause was lost sight of; and as the bended axles were universally used with narrow roads, they were continued without further inquiry, after the roads were made of sufficient width for wheels and carriages of any breadth; and without any better recommendation than their having been universally used for very many years, and no objection being made to that usage.

47. If the roads had been of a sufficient width when wheel carriages were first

used, it seems more than probable that all axles would have been straight, and the wheels cylindrical:* and, that cylindrical wheels would have come into universal use, (as if by accident;) and without any investigation or attention to the advantages that are peculiar to that shape; or, of the disadvantages that belong to the conical form of the rim; or to any other form that is not truly cylindrical.

48. This affords a striking instance of the danger of imputing effects or usages, to wrong causes; and shows the necessity of analyzing minutely every circumstance which may in its consequences, as well as in its immediate effects, become of importance: there are not wanting many instances in the construction of machinery, where considerable advantages are gained without the knowledge or design of the artist; but no improvement is secured to the public before its principles are fully investigated, and the true cause of every effect demonstrated and properly understood: for, what is got by accident, may be lost in the same manner, in the pursuit of imaginary improvement.

49. A remarkable instance of this kind, occurs in the conical form of the carriage wheel; where the increased resistance with the broad wheel, was imputed to the breadth solely; and if this had been the true cause, the increased resistance would have been as inseparable from the increased breadth as the carriers have supposed it: there would have been no difference in the resistance with a *conical wheel*, and *a cylindrical wheel of the same breadth.*

50. The resistance, of which the public carriers had so long and so justly complained, as attending the increased breadth, and flat bearing of their carriage wheels, might have been immediately removed, and all the advantages been gained that were originally intended by the legislature, by encouraging the use of broad wheels; if this resistance, which the carriers so unanimously proclaimed, and which was too considerable to escape their notice, had been imputed to its true cause; *the conical shape of the rim;* instead of imputing it to the apparent cause, *the breadth.*

51. And this want of discrimination, has made carriers, and owners of all broad-wheel carriages, strenuously to oppose the introduction of broad cylindrical wheels, being unable to conceive the difference between the effects of a cylindrical broad

* This was actually the case, with the original carrs, when the wheels were fixed on the ends of the axis.

wheel, and of a conical wheel of the same breadth; either as they regard the roads, or the labour of cattle.

52. And it seems probable, that as experience with conical broad wheels, has rivetted their unfavourable opinion against *all* broad wheels, of whatever denomination, that, if left to their own decision, long experience with cylindrical broad wheels, will be necessary to convince them of the difference of their effects, from those of the conical broad wheels to which they had been accustomed; and that the Public may yet be deprived for many years of the full advantages of cylindrical broad wheels, from the obstinancy of those, whose greatest advantage it would be to adopt them, unless some effectual means are enforced by the legislature to bring them into general use.

APPENDIX to No. II.

Observations by Mr. Cumming, on Mr. Orr's Memoir, printed in the Report of the Committee on the Higbways of the Kingdom, June 19, 1809, p. 143.

As the few observations which I wrote at the request of the Committee, on the inapplicability of the principles of the lever to the spokes of carriage wheels, has produced from Mr. Orr some remarks on my paper, I hope it may not be improper to print the following reply, as the subject is so intimately connected with the investigation which has so long engaged the public attention.

Mr. Orr says, " the following remarks are in answer to certain observations by Mr. " Cumming, on the Memoir which was presented by me to the Committee of the House " of Commons, and to the Board of Agriculture, and which Mr. C. was *permitted* to " peruse." " His observations, *with copies of some of the preceding diagrams and figures,* " are contained in the first Report of the Committee, ordered to be printed on the 2nd " of May, 1809." p. 23.

" Mr. Cumming sets out with much concern, for fear the public should be led into a " mistake regarding the height of carriage wheels; and I do conceive and trust that I shall " clearly prove, that my ideas regarding the power of wheels, are correct, and that Mr. " C—'s are *completely erroneous.*"

In his introductory paragraph Mr. Orr appears to insinuate, that I had solicited the perusal of his Memoir: the very favourable opinion which Mr. O. must naturally entertain of the merits of his own Memoir must have suggested to him, that the perusal of it must be an object of great desire, and as I cannot suppose that Mr. Orr was informed, that it was at the particular request of the Committee that I did peruse his Memoir; and that it was their wish that I should write my observations on that paper and on the diagrams generally; which I declined; but undertook to offer my reasons for differing in opinion with Mr. Orr as to the analogy between the spokes of carriage wheels and the lever; and as Mr. Orr was unacquainted with those circumstances, he is not blameable for supposing that I had solicited the perusal of a paper which he conceived to be pregnant with such important means of gaining power, as lengthening the spokes of carriage wheels.

I now come to the insinuation " that I had, in my paper, in page 23 of the Report of the 2d May, 1809, " copied some of Mr. Orr's diagrams and figures; Mr. Orr must excuse me for saying, that if I were either disposed, or under the necessity of copying the diagrams of any other person, to illustrate my own ideas, his, would probably be the very last that I would think of adopting; and if any further argument were necessary to vindicate me

from the charge of having copied Mr. Orr's diagrams, the reader, by comparing my diagrams in the plate fronting page 23 of the first Report, 2nd May, 1809, with Mr Orr's in Plate XXI. and XXII. described in page 129 of the Report of 19th June, 1809, will fully acquit me of the charge; and see sufficient reason for my having totally declined, (even at the request of the Committee,) to offer any remarks on Mr. Orr's diagrams, or descriptions, not wishing wantonly to offer my observations on the communications of any one.

If Mr. Orr had paid to the opinion of the Committee (in page 106, of Report of May and June, 1808,) that attention which it justly deserved, it might have saved him and me some trouble, and have prevented this correspondence.

The Committee say:—" On Mr. Orr's paper it has been remarked, *that velocity has " nothing to do with the advantage of wheels having large diameters, for at the point of contact, " cylindrical wheels, of all diameters, are absolutely without any velocity at all.*"—Although this observation is short, it is founded in true science; and might be deemed, by any one conversant in the principles in which it is founded, as sufficient evidence, that in carriage-wheels no power is gained by the length of the spokes, in the light in which Mr. Orr states it.

Although I cannot agree with Orr's ideas of the analogy of the spokes of carriage wheels with the lever, I admire the ingenuity and the rigid perseverance with which he defends his opinion, but cannot adopt his conclusion.

Wishing to deliver my reasons for being of the opinion that the spokes of carriage wheels were not analagous to the lever, I had supposed wheels in general to be divided into two classes, and stated the most important differences between carriage wheels, and wheels that are stationary, and that have no other motion but that on their axis; but Mr. Orr says, that " *this classification is totally unnecessary*:" if Mr. O. cannot discover any occasion for this classification, I begin to suspect that we must change our ground; and to convince Mr. Orr that I should have no reluctance in yielding to any fair argument which he can adduce, let us, for argument sake, suppose Mr. Orr's own idea to be correct, and according to his description " *of the manner in which the wheel of a loaded carriage performs " its operation.*" (see page 144).

Mr. Orr justly states, " that in the wheel of a loaded carriage, the spoke immediately " under the axis sustains the weight of the load, for the instant when it is directly under " the axis; and conceiving the lower end of the spoke at rest for that instant, its upper " end being in motion must describe an arc of a circle whose radius is the length of the " spoke." And thus Mr. Orr very logically demonstrates, that " when the carriage wheel " rolls on the surface of the road, that the lower end of that spoke immediately under the " axle is at rest, and that its upper end describes a small part of a curve of the same " radius as the wheel." " So that although, the power appears to be applied at the centre " of the carriage wheel, it does in reality act at the circumference," " *not of that wheel,*" " but of an imaginary wheel of equal diameter."

After such an argument, to support a favourite opinion, I fear that every attempt to reconcile Mr. Orr's opinion and mine, as they regard the analogy of the lever with the

spoke of carriage wheels will be in vain. But granting, that the lower end of the spoke is at rest, and that its upper end describes a very minute part of a circle of the same radius as the wheel, that part of the circle that is supposed to be described by the upper ends of the spokes, must be considered as a point only; and common observation must convince us that the line that is described by the point of the axle, and by the upper end of the spokes, in the progress of the carriage, must be parallel to the surface on which the wheel rolls; as all the spokes are of equal length, and therefore, on a smooth level road, the line of progress of the centre of the wheel must be a straight line; what then can be more absurd, than attempting to prove, that a straight line is composed of such an infinite number of circular arcs, that they cannot be distinguished from straight lines? and even then, those arcs do not belong to the carriage wheel, (by Mr. Orr's own statement) but to an imaginary wheel, which Mr. Orr found necessary to support his hypotheses; in short, what Mr. Orr says, of short circular arcs must be considered as *points* only, which may be common to a straight line or a circular arc, and as in this instance they constitute a straight line, they can have no claim to the properties of circular arcs.

Let us then recur to Mr. Orr's own mode of reasoning, in his description of his second diagram, page 129, where he says "parts of cones, and of cylinders, partake of the properties of the *wholes* of which they are parts;" and adopting the same principle generally, it will follow, that the parts of straight lines must partake of the properties of straight lines. And thus, on Mr. Orr's own principles, all those infinitely small arcs, of which he supposes, the straight line to be composed, do yet become the parts of a straight line, with all its rectilineal properties.

Although I cannot admit Mr. Orr's ideas of gaining power in carriage wheels by lengthening the spokes, there are many sensible remarks interspersed in his other observations; and the freedom with which he examines every communication that was made to the Committee, and the independent manner in which he opposes his *opinion*, in some respect or other, to *every individual*, authorises me to expect, that my differing in opinion from him will not be construed into personal disrespect to Mr. Orr.

No. III.

Observations on Wheel Carriages. By Mr. Booth, *of Allerton, near Liverpool.*

I have read two Reports of the Honourable Committee of the House of Commons, dated the 2nd and 30th of May last, on the use of broad wheels, and on the preservation of the turnpike roads and highways of the kingdom, and it appears to me that they have not gone to the root of the evil; nothing short of the absolute prohibition of narrow wheels, except for gentlemen's carriages (respecting which I shall offer an observation or two below) can effectually obtain the object in view, good roads, at a moderate expense. The total exclusion of narrow wheels is the *sine qua non* in this business, and by adopting this principle, I shall show that good roads may be produced and kept so, at a moderate expense, not only to the infinite benefit of the public, but to the real advantage of the proprietors themselves, of carriages of all descriptions, notwithstanding their restriction to the use of broad wheels solely, and that weighing machines will be totally unnecessary. The use of any wheels less than 5 inches in breadth, ought to be strictly prohibited, as it may be clearly proved that it will be the real interest of proprietors of wagons and of carts of all descriptions, that no wheel in either ought to be of less breadth than 5 inches. To demonstrate the truth of this position, let us suppose the wheel of an one horse cart to be $4\frac{1}{2}$ feet high, 3 inches broad, and the tire $\frac{5}{8}$ of an inch thick; the weight of this tire will be $89\frac{1}{2}$lbs. and the tire of both wheels double, or 179lbs. Let us now suppose a wheel of the same height, but 5 inches broad. It is self-evident that the tire of the 3-inch wheel will be reduced in thickness much faster by wear, than the tire of the 5-inch wheel, at least in the proportion of 5 to 3, therefore we may consider the thickness of the tire of the 5-inch wheel, as only $\frac{3}{5}$ of that of the 3-inch wheel, and consequently both the tires of the 5-inch wheels will weigh 199lbs. being only 20lbs. heavier, than the tires of the 3-inch wheels. Now suppose this cart with the 5-inch wheels and its load, to weigh together two tons, the increased weight, by having 5-inch wheels, instead of 3-inch wheels, is only 20lbs, as shown

above, or $\frac{1}{114}$ part of the whole weight; and if we admit that a horse in drawing such a load on the roads in general, in their present state, acts against a resistance equal, on an average, to 80lbs. the additional draught to the horse, occasioned by having the wheels 5 inches broad instead of 3 inches, will only be 6 ounces; and if two horses be used, the additional draft to each horse will be only 3 ounces. No one can be so ignorant as to contend that the difference in the draught in moving the load above mentioned on the roads in their present state, and on hard good roads, which must necessarily result from a strict adoption of the principle here recommended, will not exceed 6 ounces; and if it be added, that a greater load will be allowed with 5-inch wheels than with 3-inch, nothing certainly can exceed the impolicy of continuing the use of narrow wheels. It may be said that the felloes of the 5-inch will be something heavier than those of the 3-inch wheel, and that this difference is not taken into the above estimate. This difference, if any, is quite insignificant; for wheelwrights well know, that a 5-inch felloe may be made nearly as light, if not altogether so, as a 3-inch felloe; however, if 10lbs. be allowed for this difference, it will only cause an increase of draught of 3 ounces, when only one horse is used, and but $1\frac{1}{2}$ ounce to each horse, when two are used. It is almost superfluous to add, that the foregoing reasoning is strictly applicable to the wheels of wagons, excepting that when only two horses are used, the increased draught to each horse will be 5 ounces, but when four horses are used it will only be $2\frac{1}{2}$ ounces to each, the weight of the load being the same, viz. 2 tons, and taking the height of the hind wheel at 5 feet, and that of the fore at 3 feet. If the thickness of the tire of the 5-inch wheel be even taken at $\frac{3}{4}$ths of that of the 3-inch, the increase of draught to each horse occasioned thereby, will be extremely inconsiderable, only 2 ounces when two horses are used in a cart, reckoning the weight of the felloes equal. It may not be improper to remark, that the actual *wear* of iron on the 5-inch wheel, will be rather less than on the 3-inch wheel, which obviates any objection on the score of expense. As long as narrow wheels, which are the bane and destruction of the roads, are tolerated, the roads can never be kept even in a middling state of repair, without an immense expense; but if they be totally prohibited, as herein proposed, the roads, (after they are got into a good state, and which improvement will be facilitated by the sole use of broad wheels,) they will be kept in good order at a vastly less expense, than what is incurred at present to maintain them even in very indifferent repair; the immense impor-

tance therefore of adopting the principle recommended above, is self-evident, and it has been demonstrated that it will be for the real advantage of the proprietors of wagons and carts universally; and this will be the case even with the owner of an *one-ass cart*, as it may be proved in like manner, that it will be his interest to use a 5-inch wheel, instead of one of 1 or $1\frac{1}{2}$ inch thick: and let it be observed, that a stout ass will draw half a ton, which with the *narrow* wheel will do more injury to the roads, than a wagon with 6-inch wheels, and 4 tons weight. That all the foregoing observations respecting the breadth of the wheels of wagons and carts are strictly applicable to stage coaches, and hired post-chaise, gigs, &c. is self-evident; it will therefore be sufficient just to say on this head, that the increase of draught that would be occasioned by broad wheels to each horse in a stage coach, being so very insignificant, it will be the interest of the proprietors of these latter, to use them instead of narrow wheels.

Since the foregoing observations were made, I have seen some extracts in a magazine, from the other Reports, which have relieved me from a little difficulty I felt on one part of the subject, viz. gentlemen's carriages; for I find the Committee recommend that the wheels of these should be from 3 to 4 inches broad. The utmost I durst have ventured to propose would have been, that the fore wheels should be 5 inches broad, and the hind wheels $3\frac{1}{2}$ inches. Whatever breadth may be fixed upon for the hind wheel, the fore wheel ought to be considerably broader, on account of its being of so much less diameter. Now if it be considered how perfectly insignificant the difference of draught is, between wheels recommended by the Committee in this case, and those I might have presumed to propose, and that an approximation to the breadths of the latter, must evidently be for the benefit of the proprietors of these carriages, as well as of the public at large, gentlemen, perhaps, will not think that they are purchasing this advantage at too high a rate, by diminishing in some measure the elegance (if so it be) of the rims of their carriage wheels.

Permit me to make an observation or two on the most economical method of using the powers of the draught horse. Where a person has constant employ for two horses, I am of opinion it is most advantageous to yoke them both in one cart, for general purposes, not only in level countries, but even in hilly districts, for the following reasons.

I. A single cart may be made $\frac{1}{5}$th at least lighter than two smaller carts, to carry

an equal weight to what they both carry; for the bottom, sides, and ends, of the smaller cart, ought to be nearly as thick as those of the larger cart, consequently the weight of these parts will be nearly as their areas; but these in the large cart will not be double to those of the smaller, nor will the shafts of the former, be double the weight of those of the latter. The wheels of the one and the other, it is self-evident, ought not to be of equal height, but the wheel of the large cart may be made considerably less than double the weight of that of the smaller, yet carry double the load with equal security; and the same may be said with respect to the axletree. For all these reasons, the difference in the weight between the large, and the two small carts, will be equal at least to $\frac{1}{7}$th of the two latter, as mentioned above.

II. The first cost of the larger cart will be less than that of the two smaller ones, and the wear and tear will also be rather less. The harness also of the horses in the larger cart will cost less than that of those in the two small carts.

III. In this neighbourhood, a carter has 18*s.* per week, which makes this sum per week difference for driving; and if a man drives his own cart, his time is certainly as valuable as a common carter's. It should be considered that a carter has more to do than drive; he has to load, unload, &c.

IV. I apprehend two horses, whether yoked double or following each other in one cart, will draw with equal, if not more ease to themselves, the same weight, as if yoked in single-horse carts. Does not experience confirm this opinion? for is it not found, that the horse in the single-horse cart is at least as much fatigued or distressed as the shaft horse in the two-horse cart, and more so than the leading horse in the latter? The reason of this is evident: the exertions of the single horse are *incessant*, without the least intermission, for he is constantly upon the pull; whereas with two horses, they alternately relieve each other, by sometimes the one, and sometimes the other, drawing considerably more than one half of the whole. This relief of each other, though attended with an alternate increase of draught, does not exhaust the animal quite so much, as an incessant and unvarying degree of exertion. Suppose a man, for instance, to carry on his back a sack of corn of his own weight, say 12 stone, on a level floor, and walk very slowly for two minutes, and another man, of an equal weight, to stand the same time on *one* leg; the latter will be more distressed than the former, though his leg has only borne the same weight, as each leg of the other has on an average borne during

the same time, and though each leg of the latter has borne alternately *twice* the weight.

V. The chain horse greatly assists and supports the shaft horse when he slips or stumbles, in frost, or slippery roads, and frequently on such occasions prevents his falling, and enables him to recover with more ease from a slip or false step, which is a considerable advantage to the shaft horse.

VI. In like manner both horses yoked abreast in hilly districts assist each other alternately when one of them slips or stumbles; and for this reason it would, even in hilly countries, be more advantageous to yoke two horses double in this manner, than each in a separate cart.

VII. I apprehend that a cart of sufficient strength to carry as great a load as a strong horse can draw, with iron arms to the axle, and the wheels 5 feet 3 inches high, (and they ought to be that height at least in the present state of the roads in general,) will weigh 10 cwt. and of course two such carts, a ton; and supposing the weight of the large cart and its load, to be the same as both the small carts and their loads, but the large cart itself $\frac{1}{7}$ less in weight than both, as stated above, the difference of the weight of the goods carried will be 249lbs. Now suppose these 3 carts employed as common carriers, the large cart with two horses will carry 240lbs. of goods more than the two small carts, which at $\frac{1}{4}$d per lb. for a day's carriage, is 5*s*. or 30*s*. per week, which added to the wages of one driver, makes 48*s*. per week in favour of two horses yoked in one cart, instead of being in single-horse carts.

Every person ought to enjoy the unrestrained and unlimited use of the powers and capacities of his cattle, in the fullest extent; to abridge this right would be as impolitic in a national view, as it would be unreasonable and unjust to the individual. The legislature has only to guard against the roads being injured by the use of improper carriages. This may be completely effected by the adoption of a single principle, simple in its nature, unexceptionable, and of universal application, and which will at the same time totally supersede the necessity of having machines for the purpose of weighing carriages with their loads. It is, that the breadth of the wheel shall be in proportion to the number of horses in the carriage.

A strong horse will, in summer, when the roads are good, draw 35 cwt. including the carriage; in winter, less, in proportion as the roads are worse; and if the

wheel of the cart be five inches broad, the roads can never be injured by such a cart, drawn by one horse. It is ouly equal to $3\frac{1}{2}$cwt. on every inch in each wheel. By the schedule A. page 8, in the Report of the Committee of the 30th May, 1809, 30 cwt. is allowed for a cart with 3 inch wheels in summer, which is equal to a pressure of 5 cwt. for every inch in breadth of the wheel. In a cart with 9 inch wheels, two horses may be allowed, and with 13 inch wheels, three horses, without injury to the road.

It is almost superfluous to mention, that carriages may be constructed so that their weight shall be in proportion to the weight they are intended to carry, that is, in proportion to the number of horses by which they are drawn. It is not the interest of the Proprietor to use four horses in a cart; it will be more advantageous to use them in a wagon, or with two carts. As a wagon is in effect only two carts connected together, it may be allowed double the nnmber of horses allowed to carts, as stated above, with wheels of the same breadths as the cart wheels, and the roads will be no more injured by wagons than by carts. Those persons who have small and weak horses will of course construct their carriages, so as their weight and strength shall be in proportion to the weight of the loads they are to carry.

Suppose a person has three weak horses in a cart, (one of the most unfavourable cases that can happen) the wheel will be 13 inches broad, but if the rim be properly constructed, that is, made no heavier than necessary, the additional draught this will cause to each horse will only be about one pound more, than with the wheel of 3 inches broad, but this will be more than counterbalanced by the greater ease of draught with the broad wheel, particularly so in the improved state of the roads, which will be the necessary consequence of the entire exclusion of narrow wheels. Thus it is evident in the most unfavourable case, that the adoption of the broad wheel, will be for the benefit of the proprietor of the weakest horses that travel the road; and it will be equally or more so, for those who possess the strongest horses, as it will afford an opportunity of using their powers to the utmost extent on all occasions, without limitation or controul in any respect. There does not appear to be any rational or solid objection, either on the part of the public, or of individuals, to the adoption of the rule as explained above, and by which weighing machines will, it is evident, be rendered totally unnecessary. As the heaviest and strongest horses can never be used with advantage in stage

coaches, on account of their rate of travelling being about three times greater than that of wagons and carts, the wheels may be narrower than those of these latter, without injuring the road. In a stage coach, therefore, two horses with 5 inch wheels, four horses with 7 inch wheels, and six horses with 8½ inch wheels, cannot injure the road with any load they can draw in a trotting pace, as the horses will never be of the strongest kind, as already noticed.

Post chaise, travelling for hire, with two horses, the wheels to be 5 inches; with more than two horses, 6 inches.

Giggs, &c. with two wheels, travelling for hire, to have wheels 5 inches broad. The adoption of the principle here recommended will have a natural tendency to improve the breed of horses, a circumstance of no small importance.

The hind wheels of 4-wheeled carriages, are in general probably of the best or most advantageous height with respect to ease of draught for travelling on roads in their *present* state; it therefore necessarily follows that the fore wheels ought to be of the same height as the hind, with respect to ease of draught; the convenience of *turning*, however, requires that they should be less: but it is an important truth, and which ought to be impressed on the minds of the proprietors of such carriages of every description, that as the height of the fore wheels is diminished for the sake of *turning*, the fatigue or labour of the horses in the day's work or journey is increased; therefore the nearer the fore wheel approaches to the height of the hind, the more advantageous it will be in point of draught.

Mr. Cumming has made various observations on the properties of wheels of different diameters, all of which are very correct, and familiar to every one conversant with the subject; but they only relate to wheels moving on perfect planes, but are inapplicable to the case of wheels moving on the roads as they actually exist; and Mr. Orr's opinion, that the power is increased by the increase of the diameter of the wheels travelling on such roads, is in reality perfectly right; though perhaps if his ideas on the subject had been conveyed in more popular language, they would have been more clearly comprehended by persons in general not well versed in subjects of this nature. Suppose a loaded one-horse cart, with wheels of 15 inches diameter, and the utmost power the horse can exert for two or three seconds of time, to be equal to 320lbs. that is, he can act for that time against a resistance equal to this weight,—now suppose obstacles in the road occur that require a power equal to 330lbs. to surmount them, it is evident that the

horse could not draw the load over the very first obstacle of this kind that occurred, and of course he would not be able to proceed with the load an inch further; but suppose the wheels were $5\frac{1}{2}$ feet diameter, instead of 15 inches, the horse would draw the load over these obstacles with ease, as in doing which he would only have occasion to exert about $\frac{1}{4}$ of his power or strength. Increase the diameter of the wheel from 15 to 18 inches; in this case the horse will be able to surmount the obstacle, but it will require nearly the exertion of his whole power; and these obstacles frequently occurring, he would soon become so exhausted, as not to be able to surmount them at all: keep increasing the diameter of the wheel, and his power or ability to surmount the obstacles with more ease to himself will keep increasing also, till the diameter of the wheel approaches to 5 or $5\frac{1}{2}$ feet, which is, probably, the most advantageous height, in point of draught, in the present state of the roads. Suppose the diameter of the wheel to be only 3 feet; it is self evident that the horse would be more fatigued at the end of his day's work or journey, than he would be if the wheel had been $5\frac{1}{2}$ feet high. The fact unquestionably is, that the high wheel *empowers* the horse to perform his day's work with greater ease to himself; and therefore it may with the strictest propriety be said, that the increase of the diameter of the wheel increases his power. It is almost superfluous to observe, that the *duration* of the exertion of the horse increases in surmounting an obstacle, as the diameter of the wheel increases; yet at the same time the power requisite to surmount the obstacle decreases, by which the excessive exertions which exhaust the strength or powers of the horse, are moderated, and he is enabled thereby to perform his work with more ease to himself, as demonstrated above.

I have shown above, that it will be the interest of the owners of one-horse carts, to have the wheels 5 inches broad, and to those who use two horses in a cart, it will be equally their interest to have the wheels 9 inches broad; for the increased draught of each horse occasioned by increasing the breadth from 5 to 9 inches, will be only a few ounces, a difference scarcely worth noticing; while on the other hand, the proprietor will be entitled to carry as great a load as his horses can draw; and two strong horses on hard and level roads in summer, especially in their improved state, (which will be the necessary consequence of the use of broad wheels only,) will draw a load of 70 cwt. particularly in short journeys, carriage included; whereas at present with 3 inch wheels, and two horses, he is not

allowed nor intended to be allowed, to take a load exceeding 30 cwt. in summer, and 25 cwt. in winter, carriage included, though his horses may be able to draw double this load without being fatigued more than prudence would justify. If the felloes of a 9-inch wheel are properly fashioned, that is, in the manner of those in the wheels of what we in the country call the London wagons, the whole of the felloes in a wheel of 5 feet diameter need not exceed 48lbs. in weight, those of the 5-inch wheel; and as the thickness of the tire of the 9-inch wheel may be proportionably thinner than that of the 5-inch wheel, the weight will be nearly equal; the increased draught, therefore, will be very insignificant, as shown above. If farmers and carriers were well informed and convinced of the foregoing truths, which admit of the clearest proof, they would feel no reluctance to the adoption of broad wheels, as it would afford them the opportunity of frequently doing double the work with their horses that they now perform, and at all times more, as they would be enabled constantly to employ the whole strength or powers of their horses. They would frequently at 20 loads with two horses, carry 70 tons, including the weight of the carriage, whereas at present, they are only allowed to carry 30 tons in summer, and 25 tons in winter, carriage included, at 20 loads, though their horses may be of the strongest kind. The loss, however, sustained by the present improvident laws respecting the weight allowed to be carried in wagons and carts, is not so much that of the farmer or public carrier; for the former cannot pay a higher rent than what his industry and a decent maintenance admit of; and therefore the loss, occasioned by impolitic laws preventing him from making use of the full powers of his horses, falls upon the landlord, who otherwise would obtain higher rents; and the same may be said of the public carrier, for he must charge such a rate of carriage as will afford him a livelihood, and the public must pay it. The loss occasioned by such impolitic restrictions, is sustained by the commerce, trade, manufactures, and agriculture of the country, and not by the individual farmer and carrier, as shown above.

To sum up the whole, true policy demands that every person should be allowed the unlimited use of the powers of his horse, to their fullest extent, the legislature directing that the wheels of carriages shall be as broad as a due regard to the preservation of the roads shall require; and if it should be thought that the breadths proposed above are insufficient for this purpose, it can enact that they shall be of such breadth as in its wisdom shall be deemed necessary.

No. V.

Calculations respecting the Produce of Land in Articles of Human Sustenance. By Mr. William Pitt.

An acre of land in potatoes well managed will produce 300 bushels of 80 lbs. each. Deduct twenty bushels for seed; remain 280 bushels nett produce, or ten tons weight of food fit for the human species. This root at present stands first in the weight of human food to be produced from an acre of land, as above, ten tons.

Wheat. The produce of wheat in the best cultivated land may be reckoned four quarters per acre; in the common fields and ordinary land, two quarters; average, three quarters. Deduct two and a half bushels for seed; remains nett average produce twenty-one bushels and a half per acre; which at nine gallons measure should weigh 67 lb. per bushel. Weight of wheat produced per acre will thus be 1440 lb.

No deduction is here made for loss of land in the fallow year, very little land being here fallowed for wheat, and that little ought to produce above average, as having fewer weeds to support.

No other grain or pulse will exceed wheat here (Leicestershire) in the weight produced of good wholesome human food.

I estimate that two sheep, of 20 lbs. per quarter each, is all the mutton to be expected from grazing an acre of prime land, breeding the sheep on the premises; to this is to be added the head and pluck as eatable food. If we reckon beef or pork to grow somewhat faster than mutton, in proportion to the breadth of land they clear, the quantity of animal food produced from an acre may be 180 lbs.

Dairy produce. A good dairy cow will produce annually of cheese 480 lbs.; of veal, supposing every other calf fatted to 30 lbs. per quarter, 60 lbs. Suppose this produced for five years, from three years old to eight, this gives 2700 lbs. in five years. If fatted the sixth year to 165 lbs. per quarter, 660 lbs. of beef is to be added. Charge the rearing three years, at half price, and allow one half year's keep for whey and pork, not reckoned before: remains seven year's keep, and 3360 lbs. weight of animal food produced, or 480 lbs. weight per annum. But this cow will consume the produce of two acres of prime land annually, and therefore only produces of animal food per acre annually 240 lbs.

If we suppose the food thus produced to be equal in value and nutriment to mutton, beef, and pork, or the average of them weight for weight, then the produce of grazing is to that of dairying, as 140 to 280, or as 3 to 4; and one-fourth of the produce of dairying is raised by the extra labour therein employed.

The idea of grazing for one year an acre with feeding cattle, being in produce equal to 180 lbs. of beef, is founded upon the estimate of the profits of breeding and grazing sheep being equal thereto; and the grazier's experience will keep these things at par, as he will always increase that stock that pay him best; the hides and offal of both are thrown in, as being in produce and amount nearly analagous; it must also be observed, that these calculations are made for good Leicestershire grazing land.

Oxen. The ox bears no comparison to the cow, or heifer, in the nett produce of human sustenance; for if we suppose a bullock's keep equal to that of a cow, and that he be kept to eight years old, and throwing in the first year, call the whole seven years keep, there will then be a great deficiency compared with a cow or heifer; but graziers generally reckon upon buying in store oxen or steers, at a cheaper rate than they can rear them, from cheaper and less improved countries.

If we take the average weight of a fat full grown ox, at fourteen score the quarter, being the mean between twelve and sixteen, then the produce of that

ox for seven years keep will be - - - -	1120 lbs.
weight of beef; but the produce of a cow, as before, is -	3360 lbs.
Superiority of the cow to the ox in animal food - - -	2240 lbs.

Quere; Will this deficiency be made up by the animal working four years, viz. from three years old to seven? which is all that can be reckoned upon, as the last year must be reckoned solely for feeding up. As beef or cheese has sold latterly, this deficiency would be 2240lbs. at $7\frac{1}{2}d.$ £75.

And if the data of these calculations are supportable, it is evident that, for an ox to be as profitable as a cow, the above difference must be made out by his labour. If farmers could be convinced that this can be done, and that an ox can work as well as an horse, there would then be no difficulty in persuading them to substitute oxen for horses.

In the above calculation, fourteen acres of good land are allowed for the support of an ox, and feeding him up, at from seven to eight years old, which is two acres per annum for his full grown state, and one year thrown in.

I would allow an horse when full grown, three acres, viz. one for corn, one for hay, and one for grass, and for his immature years the same proportion as the ox; then at eight years old he will have consumed the produce of twenty-one acres against the ox's fourteen: or two horses consume the produce of as much land as three oxen; whence it is necessary, if horses are the most profitable, that two horses should do more work than three oxen, because the oxen will, at the end of the eight years, be of greatest value.

But it is believed by farmers that two horses will do as much work as four oxen; and farther, that there is a variety of business connected with a farm that oxen cannot do at all; also, that as horses are in demand, and cannot be had unless bred somewhere, it is necessary to breed them; and who can breed them but the occupier of land, who can also work them or sell them at pleasure?

It will have appeared above, that both oxen and horses are, considered in themselves, unprofitable stock, in comparison with cows; but being necessary for their labour in cultivation, the loss in keeping them must be made out by the profit in corn and grain raised by such labour.

Human Species, their Consumption of landed Produce.

I reckon that a healthy grown person of the male sex, who uses much exercise, and who has what he chooses at command, will consume in bread the produce of a pound weight of flour per day, or 365 lbs. per annum: this, allowing for the bran, will be the product of one-third of an acre according to the produce per acre before stated; and allowing for potatoes and other vegetables, will consume in vegetable food - - - - - - $\frac{1}{2}$ acre

And in animal flesh, at $\frac{1}{2}$ lb. per day $182\frac{1}{2}$ lbs. per annum, or the full produce of - - - - - - - 1 acre

And in butter and cheese the product of - - - $\frac{1}{2}$ acre

(I suppose butter produced only in half the porportion of animal flesh, or 90 lbs. per acre per annum.)

And in beverage from malt liquor the produce of at least one acre of barley - - - - - - - 1 acre

In all, supposing the land of good quality, the produce of - 3 acres

The allowance for beverage may by some be thought high, but the home-brewed

ale of my neighbourhood has six bushels of malt at least to a 40 gallon cask; so if a person drink only four pints of ale per day, it is 182½ gallons per annum, or the produce of full 26 bushels; a trifling allowance for small beer at meals will raise it up to the produce of more than an acre. I believe I can find people in plenty who would undertake to drink double this quantity, and many who really do so.

For the female sex who are grown up I would deduct the beverage, and allow them each the produce of - - - - 2 acres.

And for those beneath the age of puberty of either sex per head the produce of - - - - - - - 1 acre

In order to ascertain the breadth of land necessary to support any given number of the human species, I would divide them into three classes in equal number as above; 1, the male sex grown up; 2, the female sex grown up; 3, children of either sex; and one of each as above will consume the produce of 6 acres, or 2 acres per head per annum.

If we suppose the number of horses kept for draught, harness, the saddle, and all other purposes, to be equal to one-tenth of the number of human beings; and that each horse as before calculated consumes the produce of three acres of good land, then 30 persons and 3 horses will require 69 acres; to avoid fractions I will say 70 acres of such land; and suppose 60 acres go to support 30 human beings, and 10 acres to the 3 horses, thus the horse consumes one-seventh part of the produce of the land, and the human species six-sevenths.

But this calculation is made for the prime soils of Leicestershire; to adapt it to the whole kingdom, I would divide the land into three classes, and suppose one-third of it as good as Leicestershire, one-third only half as good, and one-third a medium between the two; then the breadth of land must be increased as 2 to 3, or it will require 105 acres of the average land of the kingdom, in its present state of cultivation, to maintain 30 persons and 3 horses, or three acres and a half per head upon the whole number of human beings.

By this calculation, seven millions of people living as is the custom now in England, would require 21 millions of acres of land cultivated for their own subsistence, and three millions and a half of acres for the horses kept for their convenience, their luxury, and their pleasure.

I know some people will object, that the allowance of land for horses is insufficient, and that the produce of much more land is consumed individually by that

animal; and so it may where they are kept in luxury; but I know that 30 bushels of oats, together with the grass and hay from the proportion allowed of medium land, will well support a working farm horse, and that if more is given to hunters, and others who make great exertions, less is also given in many cases. The same observation will hold good respecting the human species, where the luxury and extravagance of some, are counterbalanced by the abstinence or poverty of others.

If the above data were correct, it seems not difficult to deduce from them, the due proportion of cultivation of different articles to suit the present modes of living; or to point out such economical alterations as tend to support a more numerous population: thus a farm of 210 acres of medium land is to support 60 human beings and 6 horses; for the former, wheat will be wanted upon 20 acres.

Barley at least upon - - - - -	20
Oats for the horses upon - - - - -	10
Beans and pease for hogs and other stock upon - -	10
Potatoes or turnips or green crops upon	20
Wheat fallow upon - - - - -	10
Horse pasture - - - - - -	10
Cow pasture - - - - - -	40
Sheep pasture - - - - - -	40
Horse hay on 10 acres, cow hay on 20 - - -	30
	210

From this calculation it should appear, that to supply the present demand, near one-tenth of cultivated land should be sown with wheat; and the same proportion with barley; that two-sevenths of the whole breadth of land should be cultivated for grain or pulse, one-seventh green crops or fallow, three sevenths pasture for live stock, and one-seventh mown for hay.

It also appears that a much greater population may be supported from the same breadth of land, upon vegetable food, and the produce of cows in milk, and its produce, than can upon animal diet, and fermented liquors used as beverage; and that these two latter are almost equally a luxury; as an individual, by indulging in either the one or the other, may clear off the produce of nearly an equal breadth of land.

Since writing the above, I have met with the following, in Dr. Darwin's Phytologia, which I beg leave to introduce:

"Mankind are by nature partly carnivorous, and partly graminivorous, proved by this analogy—the Gentoo tribes who live solely on vegetables, and the fish-eaters of Greenland are a feebler generation than those of these parts of Europe who partake of both animal and vegetable food."

"But it is good policy in governments to prevent mankind becoming too carnivorous."—Spirits from grain, and strong ale, are called chemical poisons, thinning the ranks of society, both by lessening the quantity of food, and shortening life by disease.

"If the luxurious intemperance of consuming flesh meat principally, and of drinking intoxicating liquors should increase among us, it will thin the inferior orders of society by scarcity of food, and the higher ones by disease both of body and mind."

The encouragement of our fisheries, and of the use of fish as an article of diet, seems a great desideratum; as wholly preventing, as far as it goes, the consumption of landed produce. The importation of every wholesome article of diet or beverage, that can be paid for by our manufacturing labour, should be encouraged, till the stock in hand of our own productions is restored, which will be sufficiently indicated by the price at market; but that price must not be expected to come to the standard of former times; as, with the present load upon landed property of taxes, parliamentary and parochial, together with the advanced rate of every article purchased, and of labour in cultivation, it must in average seasons stand in a considerably higher proportion than before those additional burdens existed; and in all human probability, unless some unforeseen causes or circumstances should intervene, the average price of every article of landed produce for seven years to come, must be considerably higher than the average price of the same articles for seven years preceding the late war.

No. VI.

The following is the fifth Year's Account of the Produce of Milk and Butter, &c. from a Cow, the property of Mr. William Cramp, *of Lewes, in the County of Sussex, for this last Season, commencing the 3d day of April,* 1809 *(that being the day she calved), up to the 8th day of May,* 1810, *a Space of Time of* 57 *Weeks.*

BUTTER.	No. of Weeks.	Pounds per Week.	Quantity of Butter.	Sold at per pound. s.	d.	Total value. £	s.	d.
Twin calves at 9 weeks old sold for six guineas each - -	9	-	-		-	12	12	0
From the 6th June to the 3d July	4	17	68	1	6	5	2	0
From the 4th July to the 18th Sept.	11	16	176	1	6	13	4	0
From the 19th Sept. to the 13th Nov.	8	14	112	1	6	8	8	0
From the 14 Nov. to the 25th Dec.	6	12	72	1	6	5	8	0
From the 26th Dec. to the 26th Feb. 1810	9	10	90	1	6	6	15	0
From the 27th Feb. to the 23d April	8	8	64	1	6	4	16	0
From the 24th April to the 30th April	1	7	7	1	6	0	10	6
From the 1st May to the 7th May left off milking - - -	1	5	5	1	6	0	7	6
	57		594			57	3	0

MILK.

From the 6th June to the 3d July,	24	quarts per day	672
To the 18th Sept. - -	22	ditto ditto -	1694
To the 13th November -	18	ditto ditto -	1008
To the 25th December -	14	ditto ditto -	588
To the 26th February, 1810 -	12	ditto ditto -	756
To the 23d April - -	10	ditto ditto -	560
To the 30th April - -	8	ditto ditto -	56
To the 7th May - -	5	ditto ditto -	35
			5369

The milk being measured when milked from the cow, there must be deducted for cream - - - - 594

Total 4775

4775 Quarts of skim-milk at one penny per quart, - 19 17 11

Carried over £77 0 11

Brought over - - - - -							£77 0 11

Value of new Milk, exclusive of what the Calves sucked.

				£.	s.	d.	
From the 3d April to the 9th April 10 quarts per day, 70 quarts at 5d. per quart - - -				0	17	6	
To the 23d April -	8 ditto	112	ditto	1	8	0	
To the 7th May - -	6 ditto	84	ditto	1	1	0	
To the 21st May - -	4 ditto	56	ditto	0	14	0	
To the 4th June - -	3 ditto	42	ditto	0	10	6	4 11 0
Value of dung made this season, - - -							3 0 0
							84 11 11
Expense deducted, as in my last year's report - - -							24 14 2
			Profit -				59 17 9

The management of a large dairy, (after the plan which I have laid down), may be attended to in most of its rules. Grains seem to be the greatest obstacle. I will suppose they are not to be had at all; seven months in the year they are not wanted, as every kind of artificial food can be had in great plenty, giving a little sweet hay once a day, to keep them in a regular state. In the winter time there may be provided turnips, cabbages, and potatoes; the two former will no ways affect the milk and butter, if given moderately twice a day; carefully avoiding giving them rotten and withered leaves, and giving them plenty of sweet (green saved) hay, they will (no doubt) do much better than ranging abroad in the cold, hungry fields, labouring and fatiguing themselves for food, injuring the land, and thereby occasioning great loss of manure. *30 acres of land would be sufficient to produce food enough for 40 dairy cows (if properly managed), including for hay; where, in the common mode of feeding, twice that number of acres would not do, and they would not produce above half the quantity of milk and butter. I think salting hay, when made into a reek for milch cows, would answer a good purpose. If salt could be had reasonably, about 20lbs. to a ton of hay, shaken regularly over every layer by the makers of the reek, would cause thirst, and thereby increase

* Something more, or less: much depends on the quality of the land, and management.

milk. The quantity of food milch cows will consume, is not easy to ascertain; they should have sufficient, but not to commit waste. Cattle should not be over-fed, so as to be surfeited; little at a time, and they will eat their food clean. I feed my cow six or seven times a day.

In my statement this season, I have given no account of milk further than up to the 7th May, although she was milked up to the day before she calved *(she would not go dry)*; but the milk being brackish, was fit for no use but the hogs. I do not perceive the least injury she had sustained by it; her milk came with the calves, and as soon, and as plentiful, as if she had been dry for two months, and her calves in good and lusty condition. She is now in as great perfection for the dairy as in any former season. It will be observed, my cow produced a greater quantity of milk this season than any former one, but not a greater quantity of butter: that I cannot account for: it may be, the having twins: nature ordered it so, that they might be sufficiently supplied. It will be also observed, she produced a great quantity of milk, beside what the calves sucked; and why not make butter? The trial was made, but in vain; the cream produced was small in quantity, and poor; and every trial made to make it into butter, for many hours, was to no purpose. This strange circumstance I am quite at a loss to account for, as I always milked her myself, sometimes before the calves, and at other times after, but the milk I got produced no cream sufficient in quality to make butter.—Query, could the cow have a power of withholding the cream part of her milk from me; or could the calves have an art of sucking it?

No. VII.

Account of Hollow Draining, made in different Fields, containing about 500 *Acres, from* 1*st January to March,* 1809. *By* William Robertson, *Esq. of Lady-Kirk, in Berwickshire.**

The soil on which this work was executed, contains partly a heavy rich loam on a clay bottom, a free loam on a bottom rather retentive of moisture, and a gravelly loam with a sub-soil; generally open, but interspersed with beds of clay and sand, with a base in some places close.

The quality is very good in general, but owing to the intermixture of sand and gravel beds through the whole, water was thrown up in sufficient quantity to injure the crops, and to prevent the working of the land with advantage in due season. The circumstance which at first pointed out the propriety of hollow draining, as described hereafter, was the situation of some old sunk fences, which, when open, were of a spouty spungy nature, and were filled up by a man who had a contract, for what was deemed improvements in the lawn round my house. These fences levelled, and filled with earth without a drain at the bottom, became conductors of spring-water, which threatened destruction to all the trees, grass, and every thing else within their reach. When the evil was perceived, they were immediately laid open, and drains laid at the bottom, which set matters to right, and gave me a notion of the depth of the spring-water, as well as its consequences when forced over the surface of the land.

The drains, wherever the level will admit, are never less than five feet deep, sometimes considerably more, and never wider than will allow a man to work in with ease to himself.

The materials were generally stones, and a great proportion quarried in a free-stone quarry for the purpose; when land stones could be got, they were used.

The stones of moderate size, after cleaning the drain properly at bottom, were laid on their edges, and supported one another, after which other stones were broken on their top, amounting in deepness to eighteen inches, which prevented the earth getting down; and then the drain was filled in.

* Sent in claim of the Premium, and rewarded with the Gold Medal.

The drains were worked from their lowest level upwards, the water always following the workman, and pointing out the level. Experience showed me, that when the drain was begun at the higher end, if wet weather came, it brought such a quantity of water through the seams of sand and gravel, perforated in cutting the drains, that put an end to the work, by filling the drains with water, and flooding the land below.

In working the drains, the object was to get through the beds of sand and gravel, if possible, to a solid bottom below them; and when that was done, the point was considered to be attained with some degree of certainty. When that could not be accomplished, on account of the level of the drain, a well or hole was dug, and filled with stones, which emptying itself into the drain, was the next remedy, and attended with success. When thorns were used, the drain was made as narrow at bottom as possible, without any shoulder or projection, regularly sloping to the top; a few stones were put in at bottom to support the thorns, and the other materials carefully laid into the drain endways. From some experience, I find thorns by no means to be compared to stones, and when the others are to be had with any convenience, never should be used. Much attention should be paid to secure the bottom of the drains when they are soft; stones sink in such situations, and thorns do not answer any good purpose; the bottoms of the drains so situated, should be well cleared and cleaned, and a great bed of stones used.

I have always found, that the higher, on a rising ground, the drain is placed, (when the water is found), the more certain the cure is. A bottom may be cured by leaving the land above it wet; but if the ground above is well drained, the water is generally cut off from the bottom.

The prices of the drains cutting and filling in were as follows:—

1*s.* 8*d.*	for 3 feet deep,		per rood of six yards in length,
2*s.* 2*d.*	4	ditto.	
2*s.* 11*d.*	5		
3*s.* 10*d.*	6		

including filling and setting stones at bottom, or thorns, or whatever materials filled the drain; leading and furnishing materials to be found to the workman, which of course depend on the distance of leading or manner of procuring them. At that time the price of labour in this country was to a first rate labourer two shillings; to others from 1*s.* 6*d.* to 1*s.* 10*d.*

I have uniformly found surface water occasioned by rains, to be of no disadvantage to the land here, even to our strongest land, provided the soil is free from underwater, or hollow drained with success. The one is often mistaken for the other, before draining takes place.

On such a large scale, I cannot send the Honourable Board plans of all the drains; indeed I have them not.

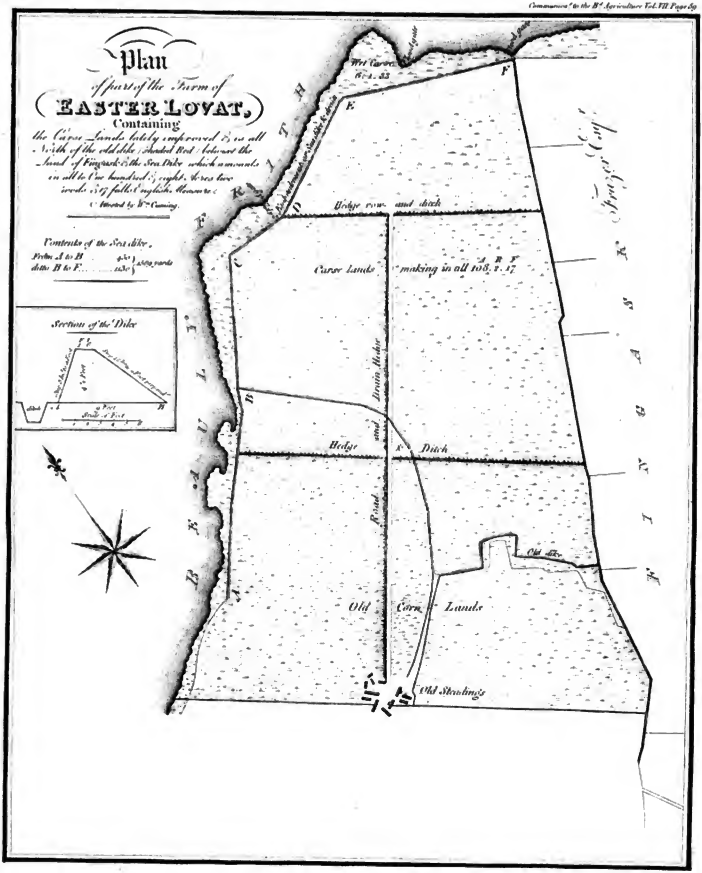
With respect to a certificate, I have none to send but those of my overseer, who superintended the work under my close inspection. I believe my neighbours and friends in the country will bear testimony to the facts which I offer, if the Honourable Board require it.

Sum paid for making drains between 1st January and March, 1809 - - - -	£1665	17	8¾
Paid for levelling the tops of drains on the grass grounds; on the tillage land this expense was not necessary. -	22	10	0
	£1688	7	8¼

The success of the operations has been most satisfactory, and most complete, beyond the most sanguine wishes of those interested.

Previous to 1809, much more has been done in the way of draining; what is mentioned here, relates entirely to that year.

I only yesterday got a paper from a friend, containing the Premiums offered; otherwise these papers would have been more accurately drawn up.


Plan
of part of the Farm of
(EASTER LOVAT,)
Containing
the Carse Lands lately improved & is all North of the old dike (shaded Red) between the Land of Fingask & the Sea Dike which amounts in all to One hundred & eight Acres two roods & 17 falls English Measure
Contents of the Sea dike.
From A to B 450
ditto B to F 1130
Section of the Dike
Scale of Feet
Hedge row and ditch
Carse Lands
making in all 108. 2. 17
Drain Hedge and Road
Hedge and Ditch
Old dike
Old Corn Lands
Old Steadings
B E A U L Y
F R I T H
Frazer Esq.

No. VIII.

On Embankments. By Mr. David Sheriff, *of Kirk-hill, in the County of Inverness.**

HAVING lately observed in a provincial newspaper, the Premiums offered by the Board of Agriculture, I am induced to become a candidate, for having reclaimed from the sea a considerable extent of rich carse ground.

At Whit-sunday, 1807, I got a thirty-one years lease of the farm of Easter Lovat, in the parish of Kirk-hill, in the county of Inverness, the property of the Hon. Colonel Fraser, of Lovat. In the summer and autumn of that year, I began and completed an embankment of 1580 running yards, agreeably to the section and plan of the ground herewith sent. The embankment cost me 1*s.* 6*d.* per running yard, every charge included, which I got executed in the most perfect manner, the inside all sufficiently opuddled. It has now stood two winters, without the sea making the slightest breach. In consequence of this embankment, I have brought into culture 108½ acres of valuable carse land, all a deep clay loam; and I have subdivided it with ditch and hedge; and by my lease am obliged to leave it fencible. No part of it was ever ploughed, or under any sort of crop, until spring 1808, when I ploughed and sowed with oats about 80 English acres; spring 1809, I sowed 70 acres, which yielded an excellent crop, and summer fallowed 10 acres; spring 1810, the whole extent will be under crop and summer fallow. Before I made the embankment, great part of this reclaimed land was covered every tide by the sea, and the whole at high spring tides. In its natural state, I do not think it was worth 3*s.* per acre; my predecessors occasionally grazed a few starved beasts on it. I have now no hesitation in valuing the 108½ English acres at 40*s.* per acre on an average; 20 acres last crop produced from 70 to 80 Winchester bushels of potatoe oats. The whole expense of the improvement did not exceed three hundred pounds, including embankment, two flood gates, and levelling and filling up the broken ground occasioned by the sea. For this and other improvements I got no compensation whatever from my landlord. By the printed conditions, I observe a Certificate must accompany this Memoir; but I see no form. I have however

* Rewarded with a Piece of Plate.

got it certified by the Minister of the Parish, and a Justice of the Peace: should this not be sufficient, it shall be done in any other mode.

Kirk-hill, January 25, 1810.

We, DUNCAN FRASER, Esquire, one of His Majesty's Justices of the Peace for the County of Inverness, and Mr. DONALD FRASER, Minister of the parish of Kirk-hill, are well acquainted with the improvement made by Mr. David Sheriff, in his farm of Easter Lovat, and have this day examined his report of it, which he means to forward to the Board of Agriculture, and we are satisfied that it is a fair statement.

DUNCAN FRASER, J. P.
DONALD FRASER, Minister.

No. IX.

Particulars regarding the Merino Sheep, imported by Charles Downie, *Esq. of Paisley in Scotland: in Answer to certain Queries transmitted by Sir* John Sinclair, *to the Spanish Shepherds who have the Charge of them.*

THE sheep in question, the number of which amounted to 103 rams, and 146 ewes, left Lisbon on the 10th July, 1810, and they were landed at Port Glasgow on the 6th of August following. During the voyage fourteen rams and four ewes died: but on board of another ship, having also a cargo of sheep, amounting to 150 rams, and 200 ewes, which sailed from Lisbon at the same time, and reached Port Glasgow six days sooner, only eight rams and four ewes died, the vessel being larger and the sheep having more air. Since they landed, up to the 21st August, twelve rams and five ewes of both cargoes have died, and about seven more of both flocks are likely to follow them. During the voyage, they were fed on barley and hay; and care was taken to keep the water put on board for them at Lisbon, as fresh as possible. The best time to import Merino sheep into this country is, when the weather is the most likely to be dry and warm, on their arrival here; and they ought to be brought over in large ships, affording them room and air.

The ram, in a good season, will produce about twelve pounds of wool; the ewe, having had a lamb, about five pounds; having had no lamb, about seven pounds. The wether about nine or ten pounds. The wool was formerly worth only about two shillings per pound; but of late years the price has doubled. The sheep are fed on the mountains of Estremadura in winter, and on those of Leon in summer. Those imported by Mr. Downie are of the Paular breed, which formerly belonged to the Prince of Peace, or Godoy. The reason of their change of pasture is, to avoid the excessive heat of the south of Spain in summer, and the cold of the northern mountains in winter. This change of climate preserves, it is believed, the health of the sheep, and consequently the fineness of the wool.

In Spain, there are many rams without horns, and they could as readily be got

over as the horned. The Spanish shepherds, who attend Mr. Downie's sheep, have seen flocks of rams without horns; and think that they are in every respect equal to those having horns.

The diseases to which the Merino sheep are chiefly subject are, 1, what in Spanish is called *La Rona*, a disease on the skin; and, 2, what the Spaniards call *Convalencia*, which appears in a tumour, or swelling under the chin. This is caused by bad grass, or bad water, or by feeding at night, which is reckoned a very bad practice:—that disease is incurable. The specific cure for the Rona is the *black oil*, a substitute for which, is water in which tobacco has been boiled. The Merino sheep are also liable to the foot rot. It is caused by the sheep feeding or sleeping on wet or damp ground. The remedy is the same, *black oil*, which is called in Spanish *Miera*. It is extracted, the shepherds know not how, from a tree called anevro, which, from their account of it, seems to be a species of fir. The oil may probably be procured from Cadiz, although at some distance from the sheep country. The shepherds do not know whether it be used for any other purpose, but for the diseases of sheep.

The Spanish shepherds, as far as they can judge, are of opinion, that the Merino sheep, under a careful and intelligent shepherd, would thrive in Scotland. By an *intelligent* shepherd, they mean one who is acquainted with the various diseases to which the Merinos are subject, and with the cure of those diseases; and who also knows the proper pasture, which should be dry, consisting of natural, rather than of sown grasses, and free from noxious herbs. By a *careful* shepherd, they mean one, who not only leads the sheep to a proper pasture, *but who every day examines them one by one*, and is thereby enabled to arrest, in its beginning, any of the diseases to which they are subject: He must also pay the most assiduous attention to his flock, both night and day, during the time the ewes are lambing. With no more care than what is bestowed on sheep in the West of Scotland, they apprehend that many of the Merinos would die before Christmas.

In dry hot weather, salt is given to the Spanish sheep. It is given well pounded, and sprinkled on the plain surface of some stones, which the sheep lick with their tongues. It serves to strengthen and fatten them.

In Spain the rams are put to the ewes in the month of July,—ten or twelve ewes to a ram. If a shepherd has under his care one hundred rams, and as many

ewes, he selects about ten of the best of the former, and allows them to be with the latter for a month or so.*

The shepherds spoke highly of the Spanish mutton, and said, though not so fat, it was higher flavoured than any they had seen in Scotland. The best season for killing mutton in Spain, is from April to November. Ewe mutton is not allowed to be sold in the shambles in Spain, it being of a very inferior quality. The ewes are not killed till they pass the age of bringing lambs. The weight of the sheep, when fed on common pasture, is from 50lb. to 80lb each, (exclusive of the hide, the head, and the entrails), but they weigh more when fattened on rich pasture. They are seldom fattened before they are killed, excepting on the demesnes of the Great, for their own table. Fattening does not injure the wool; on the contrary, it refines its quality, as well as augments its quantity, at least that is the opinion of the most intelligent Spanish shepherds.

* It is probable that it is in consequence of their having such a number of rams to select from, that the Spanish shepherds are enabled, not only to keep up, but often to improve the fleeces of their flocks. Such numbers of rams are also kept without loss, from the greater quantity of wool they produce.

No. X.

On the Destruction of Weeds. By Mr. Patrick Brodie, *of Garvald, near Haddington.*

MAGNA EST VERITAS ET PREVALEBIT.

To eradicate those weeds that are most prejudicial to his agricultural concerns, must be a principal study with every industrious farmer, and is indeed one of the most important parts of an improved husbandry. Permitting such hurtful plants to remain in the soil, is allowing them to rob useful productions of their proper nourishment; but to effect the destruction of the different kinds of weeds, often puzzles the most experienced in the profession, and it certainly requires no small degree of discrimination to adopt, on every occasion, the most effectual methods for that purpose. Indeed the same operations which destroy one species of weeds, will sometimes encourage the growth of another; and manures calculated to give health and vigour to one plant, will introduce disease and death amongst others of a different description.* Some plants are so delicate, that they can only be reared on fine soils, with rich manures, and by great attention; while others without culture thrive under all manures, soils, and climates; and by the aid of nature alone hold almost all our endeavours to destroy them at defiance.

In making a few observatious concerning the propagation and destruction of weeds, we shall not be very anxious about scientific or technical terms, being quite satisfied that most gentlemen, though well acquainted with the botanic names, are so much practical agriculturists, as to know them by the more common ones also. It is, indeed, surprising to observe how industrious nature is, for reasons unknown to us, in propagating many different kinds of plants. Thistles, for instance, are frequently propagated at an amazing distance from the parent stock. This is accom-

* Heath and some other plants thrive best on poor soils, and are destroyed by lime, rich dung, and other strong manures.

plished by the downs, which, owing to their lightness, pass through the air like so many balloons, carrying the adhering seeds along with them. Thus, mounted on their downy pinions, they travel till they fix their residence in very distant abodes. When the seeds of whins come to maturity, the pods open by the heat of the sun, and are heard, bursting their cells, with a smart crackling noise, not unlike dried thorns in the act of burning. By this explosion the seeds, which would otherwise be suffocated by falling into an impenetrable bush, are thrown over a considerable extent of ground. By these means, a few bushes on a favourable soil, soon establish a very considerable colony. A grain of wild oats turns itself every time that it is wet, provided it be allowed to dry betwixt each experiment. From their being alternately wet and dry by frequent showers, this locomotive quality enables the grains of a single head to go far asunder; each branch of the family thus apparently shifting for itself, as if in quest of new settlements. The clot-burr is of so adhesive a nature, that it lays hold of such animals as come near it, and the seeds in the heart of the burr are carried over the surrounding country. Similar observations might be made about many other agents, employed by nature to preserve any of her offspring from annihilation, and of her industry in the propagation of many other plants; but those mentioned are quite familiar, having actually come within the sphere of our own observation. Thus nature, in various ways, disseminates the seeds of different plants, and is continually exerting her prolific powers in their several reproductions. The use, however, of snch operations, in favour of plants so apparently useless, is far above our comprehension, and if we pretend to account for them, we are soon involved in conjecture and hypothesis. It may possibly be the intention of nature, thereby to stimulate the industry of man, in so far, that while he is destroying one plant, he may increase the culture of another, more useful to himself or his domestic animals. It being the business of every farmer to encourage the growth of profitable plants, and as this can only be effected by previously eradicating such weeds as rob them of their food, the extermination of the latter becomes a preliminary step to all his improvements.

Weeds, like other more useful plants, are divided into two classes, viz. annual, and perennial. The first of these are such as come to maturity in one year, or less, carry seed, and die: while the second continue in life for a number of years. Annual plants are generally propagated by seeds; perennials are sometimes propagated by the seeds, sometimes by the roots, and for the most part in both ways.

Such weeds, of course, pollute our fields, both by shedding their seeds, and by spreading their roots. Most fields are more or less infested, both by annual and perennial weeds, yet according to the quality of the soil, or the manner in which it has been cultivated, either the one or the other becomes the principal nuisance; and as they require different methods to extirpate them, a judicious farmer will bend his attention more particularly against those by which he is most materially injured. Annual weeds, being chiefly propagated by seeds which have been dropt at different times amongst the soil, are destroyed by retaining the moisture, which is best secured by harrowing soon after the plough, and thereby keeping the mould in as fine and smooth a state as possible, during the spring preparations for turnips, &c. The finer and more pliable the mould, in this case, the more seeds will vegetate; but these small seeds do not vegetate until they are within the influence of the atmosphere. New ploughings and harrowings become necessary, not only to destroy the present flow of annual weeds, but to bring up other seeds near the surface, which spring up, and are destroyed as before, &c. The drill husbandry may, in such situations, be introduced with much propriety and advantage, in the cultivation of every kind of grain. Wheat, oats, and barley, are sown by a machine, which drills these grains at about nine or ten inches distance betwixt the rows. The annuals spring up in great plenty, and are readily eradicated before they become hurtful to the grain, and are not allowed to shed their pernicious seeds. We witnessed an experiment a few years ago, upon a fine rich field in our neighbourhood, which never failed in carrying good crops, except from an overflow of annual weeds. The gentleman, to whom it belonged, sowed one half of this field in drills about nine or ten inches, and the other half in broad-cast. What was in drills yielded a very full crop, but what was in broad-cast was very indifferent, by being over-run with annual weeds, which could not be so conveniently got out as in the drilled half. The gentleman, whose testimony is deserving of the highest credit, has since told us, that the deficiency of the broad-cast was to the drilled part, as nine is to fifteen, which is above a third part of the crop, and that the half which was drilled has, ever since that experiment, been in better condition, with fewer annual weeds than the other, though always cropped in the same way, and under the like preparations. When turnips or potatoes are cultivated, the space betwixt the drills is not less than thirty inches, and the crops as abundant as if the rows were closer. Here not only the hand-hoe, but the plough

can operate with advantage betwixt the drills, so that the necessity of a plain fallow is completely superseded. Annual weeds thus become less numerous, from these operations, and the soil freed in a considerable degree from those seeds, which were wont to spring up in myriads, to the ruin of our crops, even after the best preparations. Such noxious weeds, however, can only be got the better of, by a steady and long perseverance, as they continue a long while fresh below ground, and, as was formerly observed, do not vegetate until they are brought near the surface, and under the influence of the atmosphere. Yet it is obvious that wherever drilling, and other good husbandry have most prevailed, the diminution of such hurtful plants has kept a corresponding pace with these improvements. Much as we approve of the drill husbandry, we will not pretend to argue that it may not be overdone, as we consider it might be improper to introduce it over fields of every description, it being chiefly upon light and loamy soils, addicted to annual weeds, that it is prosecuted with the greatest success. Another reason against bringing it into general practice, is the scarcity of hoers. To drill the whole crops, without having them properly hand-hoed, would tend to the increase instead of the destruction of weeds; and it is a notorious fact, that a sufficient number of hands cannot be procured to dress what is at present undertaken, though it does not amount to the twentieth part of the lands under tillage.

To extirpate perennial and root weeds, another method ought to be adopted, and as these prevail more generally in clay soils, nothing is better than a thorough summer fallow. It has been observed, that when land requires to be freed from annual or seed weeds, that the mould cannot be made too fine, nor the surface too smooth, and that the more perfectly these operations are performed, the greater number of seeds are brought into vegetation. But when it is to be freed from roots, it is much better to turn it up in large pieces, and the surface left in a rough state; for the rougher the surface, the drought is more readily admitted, and the roots more effectually destroyed. With every ploughing, the weeds are removed from their place, and the ground being in a dry state, they do not readily strike root again. Thus such weeds become weak and sickly, but, though they appeared dried and shrivelled, knot-grass, dock-weeds, and many other perennial roots, revive upon the return of moisture, after having been looked upon as dead. The most certain method, therefore, is, after the soil is properly reduced, to gather the weeds carefully from the field. The roots of

couch grass, &c. make excellent composts when mixed with new lime shells. This kills the roots very completely, and as the result, a valuable manure is thereby procured.

Having at considerable length taken notice of the cure of agricultural evils, we shall now make a few remarks upon the means by which they might often be prevented. Men, when in sickness generally spare no pains to get well; but, that being accomplished, their preventive vigilance relaxes, and too often gives way to old habits, folly, and dissipation: such conduct is not more ridiculous than that of a farmer, who after having cleaned his fields in good stile, and at a great expense, is not sufficiently careful in avoiding a return of the complaint; and it is to be regretted, that thistles, dock weeds, tussilago, &c. are too frequently exhibited carrying their seeds to full maturity, both in corn and grass fields. Thus, though it is admitted that "prevention is the better cure," the seeds of various weeds are, from a want of caution, unwillingly disseminated in farm grounds, which must at no distant period break out in a manner, that will be both difficult and expensive to remedy, as nothing less than another full course of active measures can be adequate to the cure.

There is no perennial weed more apt to elude the attention of the agriculturist in this way, than tussilago. This deceitful plant brings its seeds so soon to maturity, as frequently to mock the toils of the farmer, even in the year of his fallow. From the seeds coming before the leaf, it was anciently called *filius ante patrem;* and by their ripening so very early, the seeds are not unusually shaken before the ground has got a spring furrow. In this case, should even the whole roots of the old plants be extirpated, they have, by depositing their seeds, made sure of the succession in their own family. The industrious farmer, not aware of this two-fold attack of the enemy, wonders from what quarter he made his approach. If therefore the spring furrow cannot be accomplished in good time, it may not be improper to send hoers, two or three along every ridge; and carefully cut up such plants, so that they may be prevented from flowering, till they can be more effectually destroyed by the plough. Weeds, springing in this apparently casual manner, have led some very respectable farmers to believe in the equivocal generation of plants. This doctrine is now generally exploded by philosophers; and it is to be wished that it were in equal disrepute amongst agriculturists; for if their principles be unsound, their practice cannot be above suspicion. Indeed if a person

believe that weeds grow up spontaneously, without seeds or roots, or any other origin than the nature of the soil, we can scarcely suppose he will be at much pains in suppressing them.

There is likewise reason to believe, that much trouble arises from inattention to the choice of grass-seeds. It not uncommonlly happens that the seeds of quickens, knot-grass, &c. are mixed with the rye-grass seeds; and from their being nearly of the same shape, size, and colour, pass unobserved into fields which have been well cleaned, and at a great expense; but if there is one such noxious seed to an hundred, it is sufficient to pollute a whole field.

We have dwelt longer upon this part of the subject than we originally intended, because, as far as we recollect, the prevention of such agricultural difficulties, has been little attended to by writers upon the subject; and because we are satisfied, those evils might often be prevented, by a circumspect attention to the purity of the seeds which we sow, and by allowing those of hurtful plants to be as seldom shed in our fields as possible. Nothing indeed can be more delusive than to expect to eradicate weeds completely, by removing their roots; where they have been allowed to drop their seeds previously to their extirpation. In short, we might as well pretend to exterminate the race of moths and butterflies, by destroying them in this last stage of their existence; when their brood of catterpillars are already devouring our gooseberry-bushes and cabbages, which catterpillars must, in a future stage of their existence, become moths and butterflies.

To conclude, let us no longer content ourselves with eradicating such weeds as are come to maturity; but let us do it sooner, before they have deposited the seeds of a baneful tribe in the soil, and thereby prevent the younger race from making a party against us. Mr. Malthus has demonstrated, that early marriages ought to be discouraged, where the parties are unlikely to be able to bring up a family; and that it is better to prevent an over population, than to starve or destroy them after they come into the world. The rule may be applied to husbandry for the suppression of weeds, as it may often be easier to prevent their growing at all, than having to extirpate them after they have injured us very materially; and to use the words of that celebrated writer, let us be as attentive to the " preventive as to the positive check," and we flatter ourselves that such efforts will be crowned with success, and that we shall soon see the happy effects of well timed and judicious exertions.

No. XI.

On the Cultivation of Carrots. By Robert Burrows, *Esq. of Weasenham, Norfolk.*

I HAVE for these several years past, considered it an object of great national importance, either by the substitution of oxen in their stead, to diminish the great number of horses at present used in agriculture; or else to introduce to the attention of the practical farmer, a cheaper method of maintaining those already employed, than the one generally had recourse to; namely, winter feeding with corn and hay; an object, considering the several alarming instances we have experienced in late years, of so great a deficiency in our grain crops, as to approach almost to a real scarcity, sufficient, in my opinion, to rouse the attention of every patriotic individual to so extensive a branch of our rural economy, as the support of that useful, but expensive animal, the horse. After some observation and much reflection upon the comparative merit between the ox and the horse, I am thoroughly convinced, the former animal will not answer being introduced into corn growing countries, for the general purposes of agricultural labour, in lieu of the horse; besides, if they were used instead of horses, I am not satisfied that the farmer would be a gainer thereby; when it is considered that even the warmest advocates for ox labour, allow that it is necessary, three oxen be kept to perform the work of two horses. Admitting that to be the case, and supposing an ox to require no more food than a horse; a farmer, for the use of his plough and teams, would be under the necessity of keeping *half* as many animals again as he was accustomed to keep, when he was in the practice of using horses only. Thus if upon a farm, which requires twenty horses to cultivate it, the farmer had been in the habit of grazing annually ten bullocks for market; and now, upon changing his system, he is obliged to keep thirty oxen to do the work of his farm, he will consequently have no longer an opportunity of fattening any bullocks for the butcher; a loss to him, in my opinion, far overbalancing the annual depreciation in the value of his horse flesh. As to the assertion made use of by advocates for oxen, that they may

be kept much cheaper than horses, by only turning them, after coming from their labour, into the straw-yard for maintenance (but unless there is something very good in that straw-yard, I pronounce they will soon cut a very moderate figure), my experience and attention to the nature of animals in general, and especially such as are employed in violent or constant exercise, have fully convinced me, that whatever animals work hard, must necessarily live well, in order to enable them to perform that work; and if they are not well fed they cannot go through their labour.

Under the impression that horses are altogether best adapted for the purposes of husbandry, and at the same time, fully persuaded that they might be supported throughout the year, at a much cheaper rate than they are customarily, to the infinite great advantage of the individual, as well as to the public, some few years since I set about cultivating carrots, and the success, with which my practice has been attended, hath induced me to offer to the Board of Agriculture the result of several years experience, in the culture and consumption of that truly valuable and excellent root. Not only in its application as a winter food for horses, to the total exclusion of corn from my stables, have I been successful; but, as I shall be enabled to show from actual and attentive experiments, in feeding hogs and bullocks, carrots are capable of producing to the growers of them, a profit not only unexpected, but unexampled in the history of other vegetables, usually had recourse to by the grazier, for the purpose of fattening animals, and with this peculiar advantage attending the culture of them; the light-land farmer, who so properly depends for the goodness of his future barley crop, upon feeding on the land where he grows the whole of his turnip crop, and who consequently cannot spare, or with reluctance spares any of them for the farm-yard fold, might, by the cultivation of a few acres of carrots every year, and by feeding hogs with them, make all the straw grown even upon a large occupation, into an excellent mass of rich manure; instead of, as we too frequently see upon light land farms, an heap of mere mouldy rotten straw, carried unto the land for the future turnip crop, to the very great deficiency thereof.

I should say but little in behalf of the vegetable, whose merits are already partially known to the farmer, but rest its cause solely on such facts, as I am about hereafter to state, were it not necessary to obviate some prejudices that exist against carrots. As a preparatory crop for barley, they have been charged with being great exhausters of the soil, leaving the land where grown, totally unfit for the succeeding crop of

grain. I am persuaded, that those who bring forward such a charge, never cultivated carrots in a manner they ought to have done; and I am the more confident thereof since, as I am writing this, I recollect I have often heard those, who pretend to have grown carrots, maintain, that it is not necessary to use manure for a crop. In the name of common sense, how can a man expect to grow corn after either carrots or turnips, if he never manures for either; and at the same time, draws them for consumption off the land where grown? and when it is considered, at the same time, that both carrots and turnips are generally cultivated upon light sandy loams, that require a constant repetition of manure? I shall pass over this objection to carrots, by saying, that I have never suffered them to interfere, or put me out of my four-course system; having invariably grown them for these last six years upon my wheat stubbles after clover, plentifully manuring for the same, in the usual manner of manuring for a crop of turnips. And I shall here likewise take occasion to add, that in no single instance, have I ever found my barley after carrots, any way deficient to where I have fed upon the land one third of the turnip crop; such barleys have frequenrly been grown side by side, with each other in the same field; only, perhaps I may sometimes have manured three or four cart loads per acre more for the carrots, than I may have done for turnips; to which circumstance, is to be added the benefit the land might receive from deeper ploughing, as affording a greater facility for the roots of the grain finding their way farther into the earth in search of nourishment; (particularly to be observed in dry summers): perhaps too, we may add the additional hoeings and forking up the roots in autumn, with a three-pronged fork, as contributing in some degree to the barleys being in general as good, and in some instances, even better after carrots, than where a third par of the turnip is fed upon the land with sheep, as a preparation for barley. I state these as facts, resulting from actual and often repeated experience; and I call upon those who maintain contrary opinions, to produce facts likewise. As I before observed, if carrots are cultivated, as I understand they usually are, without preparing for them with a plentiful dressing of manure, and the crop carried off the land afterwards for consumption, the farmer has no right to feel disappointed, if he has not a good crop of grain after them: indeed he may thank the natural richness of his soil, if, after such bad husbandry, he gets any crop at all.

As I think it the duty of every individual to give publicity to any invention, discovery, or practice, that carries with it the appearance of being useful to society;

I shall, before I proceed to a statement of each year's culture, and consumption of my carrot crops, submit to the Board for their information, a few observations upon the general method I pursue in the cultivation of them, together with such other matter as will necessary mingle therewith; beginning first with the quantity of seed sown per acre, and the method of preparing the same. I usually sow seed of my own growth from 8 to 10lbs. per acre; if purchased, the price is in general from 1*s.* to 1*s.* 6*d.* per lb. By sowing seed of my own growing, I am enabled to speak both to the nature of its stock, and likewise its quality in regard to newness: the latter circumstance is of particular consequence in obtaining a full and healthy plant, and not always to be guarded against if the seed is purchased of the seedsman. Having weighed the quantity of seed to be sown, and collected sand or fine mould, in the proportion of about two bushels to an acre, I mix the seed with the sand or mould, 8 or 10lbs. to every two bushels, and this is done about a fortnight or three weeks before the time I intend sowing, taking care to have the heaps turned over every day, sprinkling the outside of the heap or heaps with water each time of turning over, that every part of the sand heaps may be equally moist, and that vegetation may take place alike throughout; during this time the land is preparing with a good dressing of manure, of about 16 cart loads per acre of rotten farm-yard manure, or cottager's ashes: the load about as much as three able horses can draw, and if bought, costs about 4*s.* 6*d.* per load, besides the carting on the land. I usually sow my wheat stubbles after clover: plough the first time in autumn, and once more in the early part of the month of February, if the weather permits: setting on the manure at the time of sowing, which is about the last week in March, or sometimes as late as the second week in April; but have generally found early sown crops the most productive. I have great advantage in preparing the seed so long before hand; it is by this means in a state of forward vegetation, therefore lies but a short time in the ground, and by quickly appearing above ground, is more able to contend with those numerous tribes of weeds in the soil, whose seeds are of quicker vegetation. Within about five or six weeks the carrots are ready to hoe; and upon an average of six years, on a light sandy loam, they have cost me 1*l.* 10*s.* 8*d.* per acre hoeing: usually performed three, and sometimes four times, or until the crop is perfectly clean: the first hoeing is with hoes four inches long, and two and a quarter inches wide. The second hoeing invariably takes place so soon as the first is completed, and is performed with 6-inch

hoes, by two and a quarter inches wide; by this time the plants are set; the first time of hoeing nothing was cut but the weeds: I endeavour to leave the carrots nine inches apart from each other; sometimes they will be a foot, or even farther asunder.

No other expense now attends the crop until the time of taking them up, which is usually about the last week in October, as at that time I generally finish soiling my horses with lucern, and now solely depend upon my carrots, with a proper allowance of hay, as winter food for my horses, until about the first week in June following, when the lucern is again ready for soiling. By reducing this practice to a system, I have been enabled to feed ten cart horses throughout the winter months, for these last six years, without giving them any corn whatever, and have at the same time effected a considerable saving of hay, from what I found necessary to give to the same number of horses, when, according to the usual custom of the country, I fed my horses with corn and hay. I give them to my cart horses, in the proportion of 70lbs. weight of carrots a horse per day, upon an average, not allowing them quite so many in the very short days; and something more than that quantity in the spring months, or to the amount of what I withheld in the short winter days. The men who tend the horses, slice some of the carrots in the cut chaff or hay, and barn door refuse; the rest of the carrots they give whole to the horses at night, with a small quantity of hay in their racks: and with this food my horses generally enjoy uninterrupted health. I mention this, as I believe some persons think that carrots *only*, given as food to horses, are injurious to their constitutions; but most of the prejudices of mankind have no better foundation, and are taken up at random, or inherited from their grandfathers.

So successful have I been with carrots as a winter food for horses, that with the assistance of lucern for soiling in summer, I have been enabled to prove, by experiments conducted under my own personal inspection, that an able Norfolk team horse fully worked two journies a day winter and summer, may be kept the entire year round upon the produce of only one statute acre of land. I have likewise applied carrots with great profit to the feeding of hogs in winter, and by that means have made my straw into a most excellent manûre, without the aid of neat cattle; the hogs so fed are sold on Norwich hill, to the London dealers as porkers: the profit of carrots so applied, I shall likewise show in my subsequent statement; together with an experiment in feeding four Galloway bullocks with carrots, against four others fed in the common way with turnips and hay.

The taking up the crop is put out to a man who engages women and children to assist him; the work is performed with three-pronged forks; the children cut off the tops, laying them and the roots in separate heaps, ready for the teams to take away. The expense altogether *1l. 1s.* per acre, of not less than seven or eight hundred Winchester bushels: the carting away depends upon the distance of the place where carried to; if not far, the expense will be from *15s.* to *18s.* per acre. The value of carrot tops given to bullocks and sheep in the first winter quarter, more than repays the two last mentioned expenses. I take up in autumn a sufficient quantity to have a store to last me out any considerable frost or snow that may huppen in the winter months; the rest of the crop I leave in the ground, preferring them fresh out of the earth for both horses and bullocks; for the former, perhaps it would be as well to wash the roots when they are very wet and dirty, though I by no means think washing generally necessary. The carrots keep best in the ground, nor can the severest frosts do them any material injury: the first week in March it is necessary to have the remaining part of the crop taken up, and the land cleared for barley: the carrots can either be laid in an heap with a small quantity of straw covered over them, or they may be laid into some empty outhouse or barn, in heaps of many hundred bushels, provided they are put together dry; this latter circumstance it is indispensably necessary to attend to, for if laid together in large heaps when wet, they will certainly sustain much injury. Such as I want to keep for the use of my horses until the months of May and June, in drawing over the heaps, (which is necessary to be done the latter end of April, when the carrots begin to shoot at the crown very fast), I throw aside the healthy and most perfect roots, and have their crowns cut completely off and laid by themselves; by this means carrots may be kept the month of June out in an high state of perfection.

Having given a general outline of the method followed by me in the cultivation of carrots, I shall now proceed to a direct statement of the expenses of four successive years' culture; their produce, and value in feeding such stock as I have been in the habit of consuming them with: in doing which, if I have been wanting in a minuteness of particulars, necessary perhaps in experiments intended for public inspection, I can only plead as an apology for the want of those particulars, that at the time of making those experiments, they were solely intended for my own use and instruction, confined to the observations of a few surrounding neighbours

only: and I have the satisfaction of learning, that since I left the neighbourhood, experiments similar to mine in feeding horses, and fattening bullocks with carrots, are now carrying on with a spirit that does credit to the enlightened individuals who conduct them.

1806.—In the first week in April, at Great Witchingham, in the county of Norfolk, I sowed six acres of carrots upon a wheat stubble after clover; the soil a fine deep sandy loam; manured for them at the rate of 16 cart loads per acre, and sowed eight pounds of seed per acre.—Expenses as under.

I wish to have it understood in the following accounts, that when I mention a cart load of manure, I mean such as, when full, requires four able horses to draw it, in the Norfolk manner; and that by an acre, I mean a statute acre; and the bushel, a Winchester bushel; by which I have always measured all my carrots out of the field at the time of carting them home.

	£.	s.	d.
Rent of six acres of land at 1*l.* 1*s.* per acre - - -	6	6	0
Composition for tythes, at 2*s.* per acre - - -	0	12	0
Poor and other parish rates - - - -	1	4	0
Ploughing the land three times - - -	6	6	0
Harrowing six times - - - -	1	10	0
Twice rolling - - - - -	0	3	0
Manuring at 16 cart loads of purchased manure, at 4*s.* per load	19	4	0
Hoeing the carrots three times - - - -	9	18	0
Spreading the manure - - - - -	0	8	0
Seed 8lb. per acre, at 1*s.* per pound - - -	2	8	0
Sowing the seed - - - - - -	0	6	0
Taking up the carrots at 1*l.* 1*s.* per acre, including the topping and laying them in heaps - - -	6	6	0
Carting home - - - - - -	5	1	0
Interest upon capital employed - - -	2	19	6
	£62	11	6

62*l.* 11*s.* 6*d.* expenses of cultivating six acres of carrots, or per acre 10*l.* 8*s.* 7*d.* Produce 5403 bushels, or per acre 900½ bushels.

Application of the 5403 Bushels of Carrots.

	£.	s.	d.
Fed nine cart horses from the 5th November to the 3d of June, 30 weeks, or 210 days. Gave to each horse 70lbs. weight of carrots each per diem, which makes the consumption of a single horse 14700lbs. weight, or for the nine horses 132300lbs. weight; at 60lbs. weight per Winchester bushel, gives 2205 bushels, valued as a substitute for oats, at an allowance of one peck per day of oats each horse, and fixing the price of oats at 32*s.* per quarter; then the value of the 2205 bushels of carrots will be 94*l.* 10*s.* or something more than 10¼*d.* per bushel for the carrots. To say nothing here about the hay eaten, which is considerably less by carrot-fed horses, than by corn-fed ones - - - - - -	94	10	0
Fed from the 26th of October to the 24th of February, 85 store hogs, bought in and sold out as porkers; they ate in the above period 1646 bushels of carrots. The prime cost of the 85 hogs, was 97*l.* 10*s.* and which were sold out for 166*l.* 18*s.* 6½*d.* leaving a profit of 69*l.* 8*s.* 6½*d.* or 10*d.* per bushel - - -	69	8	6½
Sold to the surrounding neighbours 1532 bushels at 1*s.* per bushel	76	12	0
Planted for seed, for which I charge 1*s.* per bushel, 20 bushels	1	0	0
Keeping 15 bullocks and two cows, from the 1st of November to the 18th of December, say seven weeks, with carrot tops, at 3*s.* per week each - - - - -	17	17	0
	259	7	6½
Deduct prime cost of six acres of carrots - - - -	62	11	6
Profit -	£196	16	0½

A profit per acre of 32*l.* 16*s.* is somewhat novel in a crop of vegetables, consumed by stock kept and fed on the farm; yet that, and even more, would have been the case, had I, instead of selling any, given what I had to spare from the horses to pigs. No animal that I know pays more, or is less trouble than a hog; these were less so than is general in feeding hogs. I did not trouble myself even to give them water, as they got it themselves from a pit in the yard, and milk I had none to give; their profit was solely and entirely from the carrots. My reason

for continuing to sell carrots, even after I was convinced they would pay me more for consumption, was to give the surrounding farmers an idea of their value, and which soon had that effect: those who used to be customers to me for carrots, now grow them themselves, to the amount of some hundred acres. And though perhaps I have not since been able to grow so great a crop as this, yet my subsequent ones far exceed them in point of value, as will hereafter be shown, and such vegetable crops as are usually grown in general husbandry; to say nothing of the importance of their application, as a substitute for the immense number of quarters of grain annually consumed by horses employed in agriculture. And I will take upon me to prove, to the satisfaction of any inquirer, that with the before mentioned allowance of carrots, in lieu of corn only, an horse will be enabled to perform the hardest work in the counties of Norfolk and Suffolk: and therefore let a man's prejudice be ever so dear to him, surely one might think his pecuniary interests might be a sufficient inducement for him to depart from the beaten track of his forefathers; yet sorry am I to record, that even in this enlightened county, I myself am acquainted with persons, that in many respects are very good farmers, but who suffer their apathy and indifference so far to prevail over them, as to content themselves with saying, "ay, carrots may be very good things for horses, but my men do'nt like them:" an obstacle this not unfrequently met with in the introduction of modern improvements, in the various departments of rural economy. Lamentable and degrading as it is, a thousand instances might be produced, where the ignorance and obstinacy of servants in husbandry, have been suffered by their masters to cry down an improved practice, or to banish an useful but newly invented implement of the farm; but where does the shame most attach? I shall now proceed with my accounts, only now and then making such observations as occur to me, on the revival of a subject, that has at various times employed much of my attention.

In 1807, I sowed only four acres of carrots, having received intimation from a friend, that I should probably be obliged, however unexpected, to quit my farm at the ensuing Michaelmas; of course I should not in that event have been enabled to make the most of my carrots; a crop certainly attended with a more than common expence in the cultivation; and though, what I had reason to apprehend, did not take place until two years after, as will be seen in the notice I take of my carrot crop grown in 1809, yet in this instance, it certainly deterred me from sowing a greater breadth

than four acres. I cannot here refrain from making an observation or two, upon that too common obstacle to all modern improvements, and all expensive modes of cropping, *the much to be lamented want of security to the agricultural adventurer —a lease;* without which, no man who possesses common prudence will venture a capital, that in any other line of life would secure him, not only independence, but in all probability affluence. Whilst a disposition to denial on that head, remains upon the part of the land-owners of these kingdoms, our agriculture will never arrive at its *acme* of perfection; and of course, as property, and an independent way of thinking, prevail amongst the middling classes of society, in that proportion will increase their reluctance against embarking their properties, without the necessary security and independence they are reasonably entitled to. To inculcate the necessity of, and to point out the defects of a practice so destructive to our national agriculture, as the denial of leases, or the refusal of a proper security for his risk, to the enterprizing husbandman; this, together with a strenuous and steady attempt to procure the repeal of the corn distillation bill, are the first objects worthy the attention of the Board of Agriculture. The only distinction between the two evils are, under the latter, the husbandman may probably groan only a short time; the unexpected, but pressing wants of the community, will perhaps shortly awaken the Legislature to a sense of its error, by convincing them, that the population and prosperity of the kingdom, are more intimately inwoven with the cultivation of grain, than it is with that of sugar. The former evil, so nicely affecting the private disposal of property, and its management, the hand of authority can have nothing to do therewith; all that can be effected, can only be done by the strong representation of precept, and the benefit of individual example.

Expenses of four Acres of Carrots sown in 1807, sown the last week in March; Seed eight pounds per Acre:—Preparation, a Wheat Stubble after Clover.

	£.	s.	d.
Rent of land as before, £1. 1s. per acre	4	4	0
Tythes	0	8	0
Parish rates	0	16	0
Ploughing the land three times	4	4	0
Harrowing ditto six times	1	0	0
Rolling ditto twice	0	2	0
Manuring 14 loads per acre of cottage ashes, purchased at 4s. 6d. per load	12	12	0
Spreading manure	0	4	8
Seed 32lbs. at 1s. per pound	1	12	0
Sowing the seed	0	4	0
Hoeing three times at day work, 2s. 6d. per day each man	6	2	6
Taking up with three-pronged forks, at 1l. per acre	4	0	0
Carting home at 15s. per acre	3	0	0
Drawing over the heaps, and cutting the crowns off 700 bushels for the use of the horses, in the months of May and first week in June	0	16	6
Interest upon capital	1	19	3
Expenses of cultivating four acres of carrots	£41	4	11

or per acre 10*l*. 6*s*. 2¾*d*. Produce 3040 bushels, or per acre 760 bushels

Application of Four Acres of Carrots.

Here follows an interesting experiment made with the greatest accuracy, namely, a trial how cheap ten cart horses might be kept, by feeding them with carrots and hay, in lieu of corn and hay.

I began the 28th of October 1807, to feed 10 cart horses up to the 2d day of June, a space of 31 weeks, by allowing each horse not quite 70lbs. weight of carrots each day for the first part of the winter; but saved from each horse 5lbs. of carrots, that I might be enabled, if I found it necessary, in the hard working months of the spring to increase their allowance from what I had saved in the

short days; and I found my account in the practice, as at the time the work usually became very hard, I had then an opportunity of increasing the horses' allowance, and by that means kept them in very high condition. During the autumn and winter my horses were fed as above, they did the work of an arable farm of 250 acres; carried the preceding year's crop to market 12 miles, put in 54 acres of wheat, clayed 30 acres of land 40 loads per acre, and brought from the surrounding neighbourhood of two and three miles distance, 300 loads of cottage manure. Of hay, which was likewise weighed and cut for them, they ate in the 31 weeks 15 tons 10 cwt. one stone.

	£.	s.	d.
10 horses 217 days at 70lbs. weight of carrots per day each, is 151900lbs. weight, or 2531½ bushels: estimating their value as before, at 32*s.* the price of a quarter of oats, and allowing a peck of oats per day for each horse, will give for the value of the carrots 108*l.* 10*s.* or per bushel 10¼*d.* - - - - - -	108	10	0
Fed three milch cows 10 weeks, allowing each cow six pecks of carrots per day, and 7lbs. weight of hay: 315 bushels of carrots, and 13 cwt. one stone of hay. Produce of the three cows for the 10 weeks was 230lbs. of butter, which at 15*d.* per pound is 14*l.* 7*s.* 6*d.*; valued the skim milk at 4*d.* each cow per day, as it was principally consumed in the family, and by the labourers on the farm; I have no other method of estimating its value. 70 days at 1*s.* per day for skim milk is 3*l.* 10*s.*; making together the sum of 17*l.* 17*s.* 6*d.* Deduct for 13cwt. at 4*s.* per cwt., leaves for the carrots only 15*l.* 5*s.* 6*d.*, or per bushel something more than 11½*d.* - - -	15	5	6
Sold 120 bushels, at 1*s.* each - - -	6	0	0
Planted for seed, and consumed in the family, 73 bushels, for which I shall charge 1*s.* per bushel - - -	3	13	0
Fed 10 bullocks upon the carrot tops three weeks, at 3*s.* per week each - - - - - - -	4	10	0
	£137	18	6
Deduct expenses of raising the four acres - -	41	4	11
Profit	£96	13	7

96*l.* 13*s.* 7*d.* profit upon four acres of carrots, or per acre 24*l.* 3*s.* 4¾*d.*

1808. Sowed the last week in March 14 acres of carrots upon a wheat stubble, ploughed in autumn, and again cross ploughed in February; manured as in former crops at the time of sowing the carrots; 10lbs. of seed per acre, in preparation one month previous to the time of sowing.

Expenses as under:	£.	s.	d.
Rent	14	14	0
Tythes	1	8	0
Parish rates	2	16	0
Ploughing three times	14	14	0
Harrowing six times	3	10	0
Rolling twice	0	7	0
Manuring 18 cart loads per acre, at 4*s.* per load	50	8	0
Spreading manure	1	1	0
Seed 10lbs. per acre, (though grown by myself, I shall charge it at market price)	7	0	0
Sowing	0	14	0
Hoeing three times (day work), cost 1*l.* 18*s.* per acre. Owing to its being a very rainy season, an additional hoeing was necessary	26	12	0
Taking up at 1*l.* 1*s.* per acre, including topping and laying them in heaps	14	14	0
Carting home at 15*s.* per acre	10	10	0
Drawing over the heaps in April, and sorting 1000 bushels for the horses in May, and first week in June	1	9	0
Interest upon capital	7	9	9
	£157	6	9

157*l.* 6*s.* 9*d.* prime cost of 14 acres of carrots, or per acre 11*l.* 4*s.* 9*d.* Produce 11256 bushels, or per acre 804 bushels.

Application of Fourteen Acres of Carrots.

Gave to ten cart horses from the 25th of October to the first of June, 70lbs. weight of carrots each horse per day; in the 219 days they ate 2555 bushels of carrots: valued as before, according to the

£. s. d.

supposed value of the oats an horse must have eat had he not been fed with carrots, viz. one peck per day each horse, gives for the carrots 109*l.* 10*s.* or per bushel $10\frac{1}{4}$*d.* - - 109 10 0

Fed 157 pigs bought in at different times from the 24th of October to the 20th of February. Prime cost of hogs 141*l.* 6*s.* 6*d.* } 141 6 6

Sold out 151 hogs (six having died during the winter), between the 24th of October and the 20th of May at various prices, amounting in the whole to the sum of 308*l.* 5*s.* Hogs ate 2429 bushels. Profit $12\frac{1}{2}$*d.* per bushel } - - - 308 5 0

considering this year, that probably the hogs might derive some benefit from the barn doors, I shall allow 40*l.*, which must be ample for the spoil of only two flails - 40 0 0

268 5 0

Deduct prime cost 141 6 6 Profit 126 18 6

Bought the 28th of November four Galloway beasts at 11*l.* 15*s.* each; tied them up by the head, and commenced feeding them with carrots: they ate from the above time to the 21st of March, 796 bushels of carrots, when the four beasts were sold at 23*l.* 10*s.* each, paying for the 796 bushels of carrots, (after deducting the value of hay eaten, $12\frac{3}{4}$*d.* per bushel; but I shall give a further account of these bullocks in a separate page) - - - 41 8 0

Having this year taken another farm at Weasenham, in this county, where I at present reside, I carried 2470 bushels of carrots for the horses upon that occupation; which 2470 bushels I shall value at the

Carry over 277 16 6

	£.	s.	d.
Profit brought over	277	16	6
same price my other horses are presumed to pay me for them; only I shall deduct the expense of carriage of 23 loads at one pound per load, there will then remain for the 2470 bushels 82*l.* 9*s.* 9½*d.*	82	9	9½
Sold to different persons at one shilling per bushel, 2170 bushels	108	10	0
There remain 836 bushels to be accounted for, which were partly eaten by colts, and various kinds of fowls, who are all fond of, and thrive exceedingly fast with carrots; some consumed by the labourers, and eaten in the family, with 52 bushels planted for seed; for the 836 bushels I shall charge sixpence per bushel -	20	18	0
Fed 10 score sheep from the 20th of October to the 9th of December, together with 15 bullocks upon the tops: charge the sheep at fourpence per head per week, and the bullocks at three shillings per head per week - - - - - - -	42	11	8
	£532	5	11½
Deduct prime cost	157	6	9
	£374	19	2½

374*l.* 19*s.* 2½*d.* profit upon 14 acres of carrots, or per acre 26*l.* 15*s.* 6*d.*

1809, April 1.—Began sowing 25 acres of carrots upon a wheat stubble after clover: 16 cart loads of manure per acre, and sowed the seed as in former crops, only both this and last year I increased the quantity of seed from eight to ten pounds per acre; holding it a general rule in crops of this nature to sow rather too much seed than too little, being much easier to cut up superfluous plants, than it is to supply deficiencies

Expenses upon the Twenty-five Acres.	£.	s.	d.
Rent as in former instances - - -	26	5	0
Tythe - - - - - -	2	10	0
Rates - - - - - - -	5	0	0
Ploughing three times - - - - -	26	5	0
Harrowing six times - - - - -	6	5	0
Rolling twice - - - - -	0	12	6
Manuring 16 cart loads per acre, at four shillings per load -	80	0	0
Carry over	146	17	6

	£.	s.	d.
Brought over	146	17	6
Spreading manure - - - - -	1	17	6
Seed 10lbs. per acre - - - -	12	10	0
Sowing - - - - -	1	5	0
Hoeing three times, day work, amount to 1*l.* 10*s.* 4*d.* per acre	37	18	4
Interest upon capital - - - -	10	0	0
	£210	8	4

210*l.* 8*s.* 4*d.* prime cost of 25 acres of carrots, or per acre 8*l.* 8*s.* 4*d.*

Here I must, however reluctantly, close my account of carrots as a consuming crop. The high expectations I had formed, of being able to bring forward something rather novel in the history of grazing, with the produce of these 25 acres of carrots, of which I had determined not to sell a single root off the farm, were in one moment destroyed, by receiving a notice to quit the occupation of my farm at the ensuing Michaelmas, though by a verbal agreement I had still three years unexpired: however I was under the necessity of complying, and my carrots were of course left to be valued by persons but little acquainted with them. I got for them with some difficulty 20 guineas per acre. With an intention here of resuming my experiments, I have this season sown 16 acres on my new occupat ion, and am about erecting a weighing machine, that I may be enabled to show, with the greatest accuracy, how many pounds weight of animal food for the use of man may be obtained from the produce of one acre of land only. With respect to the keeping and feeding of horses with carrots, I shall entirely rely upon my crop of next year for the maintenance of 30 cart horses in lieu of oats. Before I finish this paper, I shall present a recapitulation of the preceding statements, shewing the average cost for the first three years of cultivating an acre of carrots; likewise I shall give the average profit of the same three years, leaving out the 25 acres, as they prove nothing more than that a knowledge of the value of carrots, as an agricultural crop, is making some progress in this county; when it is considered that an obstinate prejudiced man (for exactly such was the person chosen by my successor to value against me), allowed a crop of carrots to be worth 20 guineas per acre. I shall too show, by what criterion I find the value of carrots to be equal, every 70lbs. weight, to a peck of oats, by stating the usual manner of feeding horses in this part of the kingdom, and contrast it with my mode of feeding them. Likewise I shall explain the

manner in which the four bullocks were treated, against four others turnip fed, at the same time in the usual manner of grazing bullocks in this county, with turnips and hay. With a few other explanatory statements I shall close this long paper.

Recapitulation of Expenses and Profit upon the before-mentioned Carrot Crops.

EXPENSES.	l.	s.	d.	
Upon the six acres grown in 1806	10	8	7	per acre.
Upon the four acres grown in 1107	10	6	2¼	per acre.
Upon the 14 acres grown in 1808	11	4	9	per acre.
3	31	19	6¼	
Average expense per acre	£10	13	2¼	

PROFIT.	l.	s.	d.	
Upon the six acres grown in 1806	32	16	0	per acre.
Upon the four acres grown in 1807	24	3	4¼	per acre.
Upon the 14 acres grown in 1808	26	15	6	per acre.
3	83	14	10¼	
Average profit per acre	£27	18	3½	

Expenses upon the 25 Acres.

	l.	s.	d.	
Upon the 25 acres grown in 1809	8	8	4	per acre

Profit upon the 25 Acres.

	l.	s.	d.	
Upon the 25 acres grown in 1809	12	11	8	per acre.

Expenses upon an Acre of Clover, or other artificial Hay.

	£.	s.	d.
Rent of land -	1	1	0
Tythe - -	0	5	0
Rates - -	0	4	0
Seed - -	0	14	0
Sowing - - -	0	0	3
Harrowing -	0	0	3
Mowing - -	0	2	6
Making into hay -	0	2	0
Carting and stacking	0	2	6
Interest on capital -	0	2	6
	£2	14	0

	ton.	cwt.
Produce	1	16
Prime cost of cwt.	1s.	

Expenses upon raising an Acre of Oats for Market.

	£.	s.	d.
Rent of land -	1	1	0
Tythe - -	0	5	0
Rates - -	0	4	0
Ploughing three times	1	1	0
Harrowing -	0	5	0
Rolling - -	0	0	6
Seed - -	0	16	0
Sowing -	0	0	6
Weeding -	0	1	0
Reaping and harvesting	0	9	0
Thrashing and carrying to market -	0	10	0
Interest upon capital	0	4	6
	£4	17	6

Produce 5 quarters

Prime Cost upon an Acre of Turnips.

	£.	s.	d.
Rent - - - -	1	1	0
Tythe - - -	0	5	0
Rates - -	0	4	0
Ploughing - -	1	1	0
Harrowing - - -	0	5	0
Rolling - -	0	0	6
Seed - -	0	4	0
Sowing - -	0	0	6
Manuring 16 loads per acre, at 4*s.* per load - -	3	4	0
Spreading ditto - -	0	1	6
Hoeing twice - -	0	8	0
Carting, &c. - -	0	6	0
Interest upon capital -	0	3	6
	£7	4	0

Prime Cost of an Acre of Carrots.

£10. 13*s.* 2¼*d.*

	tons.	cwt.	st.
Produce of an acre of turnips	25	17	6
Produce of an acre of carrots	20	7	1

Expenses of keeping a Cart Horse from the 25th October to 3d of June, with Oats and Hay, as is customary in the County of Norfolk.

	£.	s.	d.
27 weeks at a peck of oats per day, an horse will eat seven pecks per week, or in 27 weeks 189 pecks; value the oats at market price 32*s.* per quarter; he will then cost for oats only 189 days 9*l.* 9*s.*; but as I wish to compare only the breadth of land required to keep an horse under oats and hay, and one under carrots and hay, I shall therefore value each article at prime cost only: thus 189 days he will eat four quarters, six bushels, and one peck of oats, at 19*s.* 6*d.* per quarter prime cost - - - -	5	15	2
Carry over	5	15	2

	£.	s.	d.
Brought over	5	15	2
Hay for the same time, viz. 25 weeks, at 2cwt. per week, is 54cwt., valued only at prime cost 1*s*. 6*d*. per cwt., is 4*l*. 1*s*. for hay; but if valued at market price, would amount to 10*l*. 16*s*. 8*d*., making at the market price of articles, the expense of wintering an horse 20*l*. 5*s*.	4	1	0
	£9	16	2

9*l*. 16*s*. 2*d*. expense of keeping one horse 27 weeks at corn and hay, valuing the corn and hay at prime cost only. But this is by no means the worst part of the business; there is something farther to be observed in the above way of keeping horses; a single horse will thus be found to consume at least the produce of $2\frac{1}{2}$ acres of land for only wintering him.

Let us now see how much land it will require to keep a single horse the before-mentioned time, at carrots and hay, and what he will cost keeping upon those articles, reckoned at prime cost.

Expenses of keeping a Cart Horse 27 Weeks at Carrots and Hay, or from the 25th of October to the 3d of June.

	£.	s.	d.
27 weeks at 70lbs. weight of carrots per day, he will in that time eat 13230lbs. weight, or 220 bushels, which estimating the prime cost of an acre of carrots at 10*l*. 13*s*. $2\frac{1}{2}$*d*., and 760 bushels, or 20 tons 7cwt., the prime cost of a bushel of carrots, will then be $3\frac{1}{4}$*d*.; 220 bushels at $3\frac{1}{4}$*d*. per bushel - - - - -	2	19	7
27 weeks. Hay one horse. In an experiment before alluded to in this paper, I find it possible to keep cart horses the winter through with carrots and hay, at only 1 cwt. each horse per week: but as that experiment was perhaps conducted with greater nicety than can be introduced into general practice, I shall here allow $1\frac{1}{4}$ cwt. per week for the wintering an horse 27 weeks, or for the whole quantity $33\frac{3}{4}$ cwt., at 1*s*. 6*d*. per cwt. prime cost, is - - -	2	10	$7\frac{1}{2}$
	£5	10	$2\frac{1}{2}$

Expense of keeping one Horse 27 Weeks with Carrots and Hay, reckoning the Articles at prime cost only.

Quantity of Land required to grow the Carrots and Hay.	A.	R.	P.	*Quantity of Land required to grow the Oats and Hay.*	A.	R.	P.
Carrots -	0	1	8	Oats -	1	0	9
Hay, say an acre	1	0	0	Hay -	1	2	0
	1	1	8		2	2	29

In favour of carrots for 27 weeks keeping, one acre, one rood, 21 perches, or so much land saved to the public in the wintering of only one horse.

Produce of the Barley Crop of the six Acres of Carrot Land, 1806.

April 2d, sowed the six acres with barley seed, three and a half bushels per acre,

	Q.	B.	P.		Q.	B.	P.
Produce	29	0	2	or per acre	4	6	3

Last week in March 1808, drilled at six inches asunder, the four acres of carrot land, with barley in the same field, where turnip-land barley was growing: seed throughout the field three bushels per acre.

	Q.	B.	P.		Q.	B.	P.
Produce	20	2	0	or per acre	5	0	2

The barley after turnips, yielded only four quarters, seven bushels, two pecks per acre; but it is to be observed, the turnips were carted off the land for consumption.

April 3d 1809, and two following days, drilled at six inches apart the 14 acres where the carrots grew, with barley, at three and a quarter bushels per acre of seed. Have just now received the following account of its produce.

	Q.	B.	P.		Q.	B.	P.
Produce	85	7	3	or per acre	6	1	$\frac{1}{2}$

The rest of my crop of barley last year, and at least one-third part of the turnips consumed upon the land, yielded me only five quarters, six bushels, and three pecks per acre.

I insert the above particulars as a convincing proof that carrots are not exhausters of the soil, if they be managed in an husbandlike manner.

Account of an Experiment in fattening eight Bullocks tied up by the head; four fed with Turnips and Hay, and the other four with Carrots and Hay; with a View of ascertaining the comparative Value of Turnips and Carrots. The Turnips were of most excellent Quality, and weighed per acre in November, 25 tons, 17cwt. 6st. per acre, without their tops. The Carrots weighed without their tops, 20 tons, 7cwt. 1st. 2lbs. per acre.

Bought 21st of November eight Galloway beasts, and as I had no opportunity of ascertaining their live weight, I invited two able judges to divide the lot as equal as possible, and on the 28th of the same month tied them up: gave the carrot-fed ones six pecks of carrots per day each, with nine pounds weight of hay; and the turnip-fed bullocks had what turnips they liked to eat, with the same allowance of hay per day. At the time of tying them up, the point I had in view was not to see which would fatten quickest, if so, I should have given the carrot beasts all they would have eaten; but the favourite object I had in view, was to compare the quantity of land required under the two different crops, to produce the same quantity of animal food for market, and in an equal space of time. My observations respecting carrots given as food to other animals, led me to conclude that six pecks would be sufficient to fatten a beast of 48 Norfolk stones: the result will shew I was not much aside in my estimate.

The 7th of December, observed the carrot-fed beasts did not eat all the hay that was allowed them; as such, stopped their allowance, and gave them for the next four days only what was taken up from them.

December 11th, found seven pounds of hay would be as much per head as these last mentioned bullocks would eat: the turnip-fed ones quickly ate their allowance of nine pounds each.

January 9th, found it necessary to give the carrot bullocks one peck of carrots more per day each, as it appeared, upon nice observation, that the turnip beasts had taken the lead.

January 19th, nothing remarkable; both lots appear to be doing as well as can be expected; the weather very severe, and consequently affects stock both within and without doors. The carrot-fed bullocks now appear to have as many carrots allowed them as they can eat.

February 1st. There is now a visible advantage in favour of the carrots. I had this day the gentlemen who divided the lots, come to view: they expressed great satisfaction at the progress the whole eight had made; and were decided in their opinion, that the carrot-fed beasts had now taken greatly the lead.

Nothing afterwards occurred worthy notice respecting either lots, until the 21st of March, the time they were all sold to a Mr. William Everett, of Waltham Abbey in Essex, a jobber and butcher, at 23*l.* 10s. each; but it was his opinion at the time of buying them, that the carrot-fed bullocks were 30*s.* per head better than those fed with turnips, a circumstance sufficiently visible to the most common observer.

Expenses of feeding the four Beasts with Carrots, from the 28th of November to the 21st March, 16 Weeks.

	£.	s.	d.
They ate 796 bushels of carrots, or 47760lbs. weight, the produce of one acre and eight perches of land, at prime cost of 3¼*d.* per bushel, is	10	7	3
——— 28 cwt. of hay, at prime cost of 1*s.* 6*d.* per cwt., is 2*l.* 2*s.*, or the produce of three roods of land - - -	2	2	0
	12	9	3

Quantity of Land on which the above four Bullocks were grazed.

	A.	R.	P.
Carrots	1	0	8
Hay	0	3	0
	1	3	8

Expenses of feeding four Bullocks with Turnips and Hay, against four others fed with Carrots and Hay: from the 28th November to the 21st March following.

	£	s.	d.
They ate 146496lbs. weight of turnips, the produce of two acres, two roods, four perches of land: prime cost thereof - -	£18	4	10
——— 36 cwt. of hay, (nine pounds per day each beast), produce of one acre of land: prime cost - - - -	2	14	0
	20	18	10

Quantity of Land required to fatten these four Bullocks with the above-mentioned Articles.

	A.	R.	P.
Turnips	2	2	4
Hay	1	0	0
	3 .	2	4

In favour of carrots, one acre, two roods, 36 perches, or so much land for the grazier to devote to whatever purpose he pleases; at least the public must be a gainer thereby.

I shall forbear making any farther comments, having already extended this paper to a much greater length than I originally intended; but shall conclude, with subscribing myself,

Most respectfully
Sir,
your obedient humble servant,

ROBERT BURROWS.

Weasenham near Rougham,
May 22nd, 1810.

No. XI.

On Hay-making in general, and particularly in Wet Weather. By Mr. James Milner, *of Scortan, near Catterick, in Yorkshire.*

THE various treatises that are extant on this subject, seem to be written by gentlemen farmers, who have not had sufficient manual practice in the art, or by practical farmers, who are, in general, deficient in writing in a clear and scientific manner on the subject, though very conversant and knowing in practice.

As I have had very extensive practice for near 50 years in the art of hay-making, and have paid great attention to the various methods made use of in all the northern counties, in some of the midland ones, and also those near the metropolis; I may lay a claim, at least, to experience, resulting from a variety of observations, trials, and comparisons.

I shall now proceed to give an account of hay-making as it is practised in Wensley Dale, a valley situated about 15 miles south-west of Richmond, Yorkshire, nearly 20 miles in length, and five or six on an average in breadth, where the soil for pasture and meadows is extremely rich; land there 50 years since let at two pounds a statute acre, though far from any good market town.

Respecting the cutting of grass, the method is nearly the same throughout Great Britain; but good practical farmers prefer cutting it very low, rather than highish, because they say it vegetates much sooner, and grows much quicker, after low-cut grass, than high-cut; the crops therefore of both the hay and after-grass will be greater. The day after it is cut, in Wensley Dale, it is strewed with the hands in such a regular and even manner, that no sops, or lumps of grass appear on the surface. Neither forks nor rakes are used in this part of the work, except where the grass is very light indeed.—This method requires industry and care, but when it is well executed, the hay is half won. The next process, the day after, if the weather be fine, is to turn it with the rake-head, in a very neat and regular order. The day after, if the weather be fine, they put it into hand, or lap-cocks. One raker, man or woman,

for both are expert at the business, goes before a cocker; each cocker takes up about 10 or 12 pounds weight of hay, shakes it up very lightly, then puts one hand a little under it, and the other on the side of it, takes it up and sets it down again gently where it is clean raked, in a neat, regular row, leaving an aperture or hole about the middle in the side of the cock, so as to admit air in case of wet weather; always making them even and smooth at the top. Cocks made well in this manner, will, on account of their lightness and smoothness, certainly repel the rain, and throw it off better than any large cocks, heaped up carelessly and hastily, as they generally are, with the rake or the fork; besides, in wet weather they dry considerably sooner, on account of their lightness and good shape, and will stand better than larger made cocks, even in windy weather. This seems rather paradoxical, but it is a certain fact: for when the wind takes hold of a larger badly made cock, it will sometimes hurl it into the air, and perhaps carry it into another person's premises, whereas the small well made lap, or hand-cock, remains in security, receiving very little damage, though it has stood the blasts of several tempests. This part of hay-making, I am fully persuaded, from long experience and a variety of observations in different counties, is preferable to any I have ever yet seen.

The farmers considers the hay in this state, *i. e.* in good lap-cocks, as nearly won, and will never venture to spread it about again, though it wants a little drying or hardening, till they see the greatest probability of a fine day, when they again, if the prospect be favourable, about 11 o'clock, spread it out regularly with the hands in the same manner as strewing it; it is then tedded, or put into rows, and carried in sledges to be stacked. Taking it off the ground in sledges, is not perhaps so ready as sweeping, but the sweep injures the hay much more by the different lumps or rolls of hay that it has collected, which very frequently mould, and injure several parts of the stack or rick.

The Wensley Dale farmers likewise are superior in point of making their ricks, &c. They seldom make long ricks, as in the south, but round ones, nearly cylindrical till they are about two-thirds of its height; then a conical form takes place; then the rick is carried up to such a regular point, and roped so closely and nicely, that neither wind nor water can penetrate: in short, the ricks are less injured by time or tempests than those that are covered with straw, which is the common practice in most counties. The reason is evident, because the stacks that are

covered with straw, are seldom carried regularly to a top; they are generally too broad there, and the straw is then laid on very injudiciously and without method: the rick, consequently, in time, takes water, and a considerable part of it becomes putrefied litter. By the carelessness of servants, and the want of a judicious and philosophical knowledge in most farmers respecting the figure and finishing of ricks, their losses cannot but be considerable. The true figure of what is generally called a round stack, or rick, is at the bottom part the lower frustum of a spheriod; nearly at the middle the diameter is about one-eighth greater; then it is gradually raised, and finished in a neat conical manner. Perhaps it may be asked, why the Wensley Dale farmers are so celebrated throughout all the northern counties for hay-making? Wensley Dale is, perhaps, one of the worst situations in England for winning hay soon, being totally surrounded with high hills; that on the south is the noted Penny Hill; and there is another called Wherring-side, at about one mile distance from it, 13 feet higher, though seldom mentioned in history. These hills powerfully and frequently attract the clouds, which cause considerably more rain to fall there than in a level champaign country. These disadvantages, added to a great desire of winning their hay crops well, as they have very little corn, long since incited the farmers to pursue various methods, and to make comparative trials, till at last they decisively and justly concluded the present method eligible and preferable; and by the invariable practice of which, they acquired their acknowledged and merited celebrity in hay-making. It will be hardly credited, perhaps, when I say, that fifty years back, the men received there for their daily labour two shillings and sixpence, the women one shilling and sixpence, and the boys and girls from ten to fourteen years old one shilling each, including their victuals, which in the hay harvest were always good, and in great plenty; for they eat no less than five or six times a day; this fully shews their peculiar attention both to their labourers and hay harvest, and also their wish to excel in the art. Their working hours in Wensley Dale are certainly longer than in most other places; but when people can, and are willing to work long hours, they undoubtedly merit extra wages, and both the master and his labourers are ultimately and mutually benefited: for it is a general and just observation, that if hay be neglected, and not won in proper time, a considerable part of its nourishing qualities will be greatly injured, and consequently incalculable losses sustained. In dry weather, where the grass was very heavy, I have often seen hay, by strowing and cocking it in the above manner, won-

two days sooner than other farmers have won theirs, who were careless, and followed no regular plan in these two principal points, strowing and cocking; and I have moreover frequently seen, particularly in long wet weather, hay made in this regular, and as it were philosophical manner, won sooner by three or four days than by any other process whatever.

No. XIII.

An Account of an Experiment on Oats; with some Observations on the Nature and Cure of the Foot-Rot in Sheep: By Richard Worthington, *Esq. of South End: transmitted by* Dr. Jenner.

South-end, November 14th, 1809.

It is said to have been the opinion of the Rev. H. Close, "that a clear saving of five millions sterling per annum might be made in the article of seed corn, and double that sum in the produce, and application of that produce, by the improved system of husbandry, as at this moment practised by some few spirited farmers." Granting this deduction, the result of Mr. Close's inquiry and calculation, to be just, it appears, that by the present imperfect state of tillage, taken in the aggregate throughout England, fifteen millions annually are lost to the nation. Vast as is the prospective saving in the single article of seed corn, I conceive the calculation to be not only within the limits of truth and reality, but that if, under the plan of agriculture to which Mr. Close alludes, such a saving, and such subsequent profits are fairly practicable, much more than double that amount may safely be promised to the country, by the employment of the drill plough and horse hoe, on a scale of practice more in unison with the principles of the immortal Tull, than that from which Mr. Close has formed his interesting deduction; and who, I believe, always supposed, and commonly allowed, a Winchester bushel per acre, or at least three pecks.

As far as the result of a solitary experiment may be admitted in illustration, if not in support, of so bold, and what will probably be pronounced so adventurous an assertion, I beg leave to communicate it to that enlightened and patriotic Society whom I have the honour of addressing, and from whose spirited and unremitted exertions in the great cause of rural economy, becoming every day more awfully important, the country cannot fail to derive substantial and lasting advantage, in a ratio proportioned to her docility and zeal.

We have been judiciously admonished by the masters in agricultural science, that experiments are most safely and most pertinently planned, and conducted, on a contracted scale. Where these are various and many, the counsel cannot admit of dispute, nor even of hesitation; and indeed, where little is to be done, where the experiment stands single, as in the instance I am now briefly to adduce, there can be no doubt that safety, at all events, is best provided for by narrowing the measure of operation.

Confiding in the justness and in the approbation of this principle, I will venture to record the management, and the effect produced thereby, of so small a portion of land, as one statute acre and a half, with a residue of 334 square yards.*

The grain chosen for the purpose was oats.† These were drilled in the above quantity of land on the 5th of April last, after one ploughing, one rolling, and one harrowing. No manure used. The intervals, or distances, between the drills, were thirty inches. Rows single. Quantity of seed sown, nine quarts. On May 18th they were horse hoed, by turning the soil from the plants. On 20th June this operation was repeated, by again turning the soil from the plants. On July 4th, the soil was returned to the oats, very imperfectly, by the hand spade; for the employment of which, the reason shall be given in the sequel. Reaping and binding of the crop commenced on September 1st.; but, by the interruption of violent and continued rains, it could not be brought home before the 9th of the month. Produce, thrashed and measured, amounted to seventy-four bushels, Winchester. Quantity of grain shed, scuffled and harrowed in, and now growing and grazing off, has been estimated at eight bushels, which I conceive to be the lowest calculation admissible; and of which the reader may form a competent judgment, when I remark, that if the present growth was to be left, and should endure the winter, such is the extreme thickness thereof, that it could never make a crop worth harvesting: and hence I incline to believe, that the seed spilled, would be found to amount more nearly to twelve bushels than to eight, if certainty could be attained. But, take it at eight bushels; we shall then have a produce of eighty bushels from nine quarts of drilled seed; a return of two hundred and eighty four fold, with a fraction of four: and this, I presume, will be esteemed a

* 334 square yards exceed the sixteenth of an acre only by 42 square yards.

† The seed oats were of a kind not well adapted to the drill; rather long and husky, or what are termed, in the northern counties more especially, leather backs.

fact worthy the attention of every agriculturist. I must, in this place, advert to an injury sustained by the crops, which it is impossible to estimate, but which I consider of first importance in the general calculation. This occurred in the first hoeing of the plants, when, by reason of an ill adapted plough, and by having to contend with a soil highly unfavourable to the purpose in view, perhaps a third part of the plants was either buried or laid flat by the spilling or shivering of the soil on the left side of the plough; the consequence was, partly destruction; partly, diminished and irregular vegetation; some stems of the plants taking the lead of others, and thus producing an under and later growth. Hence, five bushels and a half of the crop proved, on dressing in the barn, to be unripe, unfilled grain; and if I may be allowed to conjecture the quantity actually destroyed by this burying of the infant plant, I should appreciate it, certainly, on the most moderate calculation, at eight or ten bushels. Granting this measure to be correct, had the misfortune not happened, the produce of nine quarts of seed would have amounted to 90 bushels Winchester, or ten bushels for every quart sown. It seems worthy of remark, that this crop preserved its full and healthy colour, a deep blue green, through heat and drought, till within a very short time before perfect ripening, when other neighbouring crops of various broadcast grain appeared to be parched or dead in the stem and leaves, while the head itself was immature; but the heads of these oats were certainly the first parts of the plants that ripened to perfection; a fact not to be overlooked nor carelessly estimated; because, under such circumstances, they received all the sustenance which a healthy and vigorous vegetation could possibly bestow. The quantity of what is, in common language, termed the hackle of the oat, particularly engaged the eye of those not accustomed to look at drilled corn. The average of produce in each head may be estimated at 400 grains: the best headed contained above six hundred. The highest plants I happened to pick out for measurement, had arrived at five feet ten inches; the circumference of the largest stems measuring an inch, and the broadest leaves an inch and a half. To many I fear this detail will appear minute and prolix: others may, at the same time, feel some interest in the description: it will, at all events, serve to illustrate the power of the horse-hoe in producing a luxuriant growth of plants.

I must now beg leave to make a few remarks on the circumstances to which the land was exposed, previous to its receiving the seed from the drill, and on the quality of the soil itself. In the first place, its situation affords an example of an

unaccountable error which we occasionally mark in some districts, viz. the appropriation, to tillage, of land which lies within the reach of flood. During the inundation of last spring, the little parcel of land I have specified, which forms a portion of a field of four acres, was, in common with the rest of the piece, deeply and permanently flooded with the back water of the Severn. This will account for my late sowing, and the hasty and insufficient ploughing of the land. By a flood, in the preceding winter, I had lost on the same field a crop of drilled wheat. From these repeated floods lying long upon the land, the water not containing the fertilizing ingredients which, in a greater or less degree, accompany the muddy current of the river, the staple of the soil was impoverished and chilled. After the spring flood it long remained too soft and washy for the purpose of aration; and was finally so baked and bound, that three stout draught horses ploughed it with difficulty.

In the preceding year, the portion of land, on which the oats grew, was cropped with pease and potatoes, without the employment of manure. The potatoes (a few rows excepted) were set at intervals of one yard; the distance between the sets in the drills half a yard. The quantity of seed used, as nearly four Winchester bushels, heaped, as could be calculated after setting; and I believe the calculation is very correct. The quantity of land occupied was 3040 square yards, or 1800 square yards less than one acre: produce, 333 Winchester bushels, heaped, of large sized potatoes, with the exception only of 13 bushels, which were considered too small for mixture with the others. The kind, what are called here and in Gloucestershire, blue kidneys. There is some reason to conclude, (and perhaps it has already been ascertained by others) that as good a crop might be obtained from what are vulgarly termed potatoe spirts, as from the potatoe itself. I set one of these during the first week of May, of about six or eight inches in length, in my garden. On taking it up on the third of the present month, I found it had produced seventeen potatoes, many of them bulky; and on weighing the largest, it proved to be exactly one pound. Once, and once only, I tried the effect on a few feet of garden ground, of setting the eyes of the potatoe, picked out with the point of a pen knife, so as to leave, at each eye, a bit of potatoe adhering, not larger than the bulk of a very small pea. A crop was produced, but the haulm was poor and languid, and the produce contemptible. I can have little doubt that, from the spirts, a crop may be depended on; and I am not led to

this conclusion from the single instance I have recorded, but from the vigorous and luxuriant growth of several scores of plants, which were this year accidentally produced from a similar origin, on land where I could not allow them to remain.

To return to my first subject. The soil of this field is uniformly the same; a combination of binding clay and sharp gravel, abounding with stones of a considerable size, and whimsically designated in this vicinity, perhaps in language of ridicule, stoney acre. It lies on the level with a neighbouring gravel pit. I have reported that the two horse hoeings were performed by turning the soil from the plants: the first of these was performed in this way by choice, the second by necessity: for, when the time arrived for returning the soil to the plants, it was found in a condition so baked and bound, and turned up in clods so large and hard, that had I persevered in the then desirable mode of returning the soil, I might indeed have bruised and broken every plant in the drills, but could never have succeeded in earthing up, or in loosening the soil properly at their roots. I had therefore only a choice of evils—either to plough again from them into the intervals, or to allow the corn to remain perfectly root bound. I preferred the latter, under the hope that, in a few days, rain might fall, and render the soil fit to be returned. For this having long waited in vain, and observing the crop was becoming knee bent, the application of the hoe plough being still impracticable, I caused the ridges in the intervals to be skimmed, (as far as skimming was practicable) by the spade, and the scanty portion of adapted soil, so obtained, to be thrown up to the plants—a miserable substitute for deep ploughing.

Such is the history of the husbandry practised upon this miniature quantity of land; and should it, such as it is, be thought worthy the attention of the Board to whom it is respectfully addressed, I shall feel highly gratified, in having offered it to their notice: and I may hence be encouraged, could I esteem it worthy of their acceptance, to transmit the result of a similar husbandry, in reference to a small and very promising crop of drilled wheat, of mine, now growing on a more favourable soil: intervals 30 inches; quantity of seed, seven quarts per stutute acre.

I must yet beg leave to subjoin one remark in relation to the oat crop, just described, which is this: that, by what I have communicated, I by no means intend to illustrate the power of the horse hoeing husbandry, according to the plan of its application just mentioned, but to record what it has done in the

instances adduced, when opposed by circumstances peculiarly unfavourable and injurious.

Under the possible supposition that this report may meet the eye of some cultivator of the soil, who may be induced to subject my mode of practice to the use of his own experience, and (by leaving a fair allowance of interval between the drills of his corn) to give the horse hoe its due and effective application, I feel called upon to remark, that the horse hoeing husbandry requires two narrow hoe ploughs, one to plough from the plants; another to plough up to them. The first may have the beam (or perch) moderately curved towards the right side of the plough, agreeably to the form of ordinary ploughs; but that it may not spill or shiver the soil upon the plants on its left side, which is of course always turned to them while the soil is throwing into the intervals, it is necessary for the coulter, first, to be perpendicular to the soil; secondly, to stand nearly as far forward as the point or nose of the ploughshare; thus cutting the surface directly perpendicular to the said point as it works in the soil below: thirdly, that a flat plate of iron should fill up the usual vacancy seen, in the common plough, behind the coulter; to prevent the passage of soil from the right to the left side, which would otherwise pour upon the plants as if it was intended to bury them.

All evil is prevented, and the work neatly and effectually done, by the precautions now suggested.

The other plough, (viz.) that intended to return the soil to the plants, must have a straight beam or perch, without which it will be found impracticable to mould them up neatly and effectually, and at the same time to plough sufficiently deep; and, unless the latter practice is observed, both in ploughing to and from the plants, the effect of the horse hoeing husbandry will be very imperfectly produced. It may be imagined, that, by the addition of a notch to the common curved beam plough, a substitute for a straight beam will be easily obtained. I have tried this in its utmost latitude, and have uniformly proved it to be a fallacious expectation. I believe a beam or perch, somewhat curved to the left side of the plough, will act better than one entirely straight, for ploughing to the plants; and I have accordingly ordered such an one for my own use. This will allow the horse, or horses, to walk at such distance from the drills of corn, as to secure their perfect safety, while it completely moulds them up and works deep. I preserve a distance of thirty inches between

the drills, because it is the narrowest interval in which a draft horse of strength can walk without disturbing the plants, particularly when the crop is advancing to maturity, the season, above all others, when the hoe plough is most beneficial; but by no means for this reason only; for, taking all circumstances of advantage into the account, which it is not my purpose here to insist upon, I conceive it to be the most appropriate distance at which grain can be cultivated, under the drill husbandry.

I will conclude my remarks on the subject before us, by taking the liberty of advising every as yet unpracticed operator in the horse hoeing agriculture, to have his hoe ploughs made on a scale as little cumbrous, as is consistent with the work they are to do: that is, with the quality of the soil in which they are to move; and, more especially, to have them formed very narrow throughout; the moulding board to be furnished with hinges at the fore part, and a long screw at its binder extremity, for the necessary purposes of expansion and contraction, agreeably to the width of the intervals: for, though he can never horse hoe effectually and repeatedly, on a surface less than that of thirty inches between the drills of corn, he may occasionally wish to try the result of an interval some inches wider. It may not be useless to note, that, in ploughing up to the plants, the moulding board, which as I have before observed should be supplied with hinges, ought to be set an angle two or three inches less acute than the measurement of half the interval: thus, in ploughing along the middle of the interval, when the drills stand at thirty inches apart, the moulding board should be fixed at, or be opened to, an angle of twelve inches, or thereabouts: if it stood at an angle of fifteen inches, the plants, if small, would be partly buried by the soil; if well grown, they would be partly broken, partly thrown into an inclined direction; while the correspondent moulding on the other side of the row, though it might contribute to restore their upright position, would still act mischievously by burying many of the lower leaves, and by bending down and cramping the whole of the plant. These remarks are minute, but they will be found practically serviceable in the field.

To this little communication on the subject of the drill and hoe, I beg permission to subjoin the result of what I have had occasion accidentally to observe in the disease,

so prevalent at this moment, among sheep, of various breeds; I mean an affection of the feet, producing obstinate lameness, and, if not cured, terminating in the decay and gradual destruction of the foot. I am informed by an eye witness, that the Spanish flock of His Majesty, which were lately imported, are almost universally attacked by it. I could refer to it at present in the new Leicester breed; and a small flock of Anglo Merinos, belonging to me, are not yet free from it. The principal remark I have to offer on the subject, (I don't know it to have been insisted upon by any other person, nor the caution hence arising, any where suggested) is, that by whatever name the malady may be announced, it is certainly and actively infectious. I am led to this conclusion, first, from what I have lately noticed in my own sheep, and the instance seems strongly to corroborate the fact.

From my small Ryeland flock I selected ten ewes, and turned them into the same ground with my Anglo Merino sheep, some of which* I observed to limp, but did not suspect any actually morbid state of the foot to be the existing cause of the lameness. Gradually the disease spread among the flock, and led to an examination of their feet, under an alarm of what is denominated the foot rot. The appearances came in proof that such was the nature of the disease. Still I left the Ryeland ewes, yet sound, with the Anglo Merino flock, that they might all be with the same ram. The Ryelands presently became affected with the disease in the foot.

The evidence of infection, in this instance, is therefore founded on the simple fact, that the Ryelands, when mixed with the diseased Anglo Merinos, were themselves quickly diseased; while the Ryelands, of the same flock from which these ten had been selected, continued to remain perfectly sound. It is necessary here to apprize the reader, that no difference in the circumstances of the land, on which the flocks have been kept, will by any means explain the fact I have related; nor any known circumstance whatever, except that one part of my Ryeland flock was turned among sheep labouring under disease, while the remaining part was withheld from all communication with them. I had not any sheep diseased in the feet, till the Anglo Merinos arrived here, nor had any such disease ever previously attacked my flock.

I am sorry to observe that the result of my report, on this occasion, is in direct hostility with the suggestion of Mr. Lawrence, who, in his valuable Treatise on

* The Anglo Merino.

Cattle, Sheep, &c. (p. 619) supports the opinion of the foot-rot not being contagious. He does not, however, defend this doctrine by any appeal to experiment; and indeed the remark, introduced by the author in the succeeding page, where he refers to the practices observed in Lord Somerville's flock, if I properly understand it, tends to oppose and invalidate his sentiment. Speaking of that flock, the writer says, in allusion to the disease of the foot, that Lord Somerville's "Merino and Ryeland sheep were in some degree affected, but that the disease was entirely prevented, or rooted out, by a careful selection in autumn, &c. &c." By a careful selection, I presume is meant a separation of the infected from the sound division of the flock, by which the spreading of disease was obviated.

To me it appeared, from what I had lately witnessed in my own flock, to be a disease so actively infectious, as to offer a prohibition against the pasturing of sound sheep on land which had been long and recently trodden, and laid upon by those affected with it. I had really conceived this apprehension, before the following case in point came to my knowledge, which I must here beg leave to offer as the second example, whereupon I found an opinion, that this disease is infectious. My relative, Mr. Worthington, resident in Cheshire, who at present cultivates the new Leicester breed of sheep, not long ago purchased half a score of that kind at Lord Anson's, in Staffordshire. They most unfortunately proved to be diseased in the foot. Seven of the number, after obstinately resisting the usual means of cure, were disposed of to the butcher. As soon as these seven uncured sheep were removed, the remaining three were also turned upon other land; and a flock of lambs, perfectly sound, that had been kept separate from all other sheep, were pastured in the field from whence the ten aforesaid ewes had been withdrawn. It happened that the bulk of these lambs was quickly parted with, and nine only remained upon the field:—of these, five soon became lame, and were bandaged up nearly a fortnight ago; and if a separation or "selection" has not been made, I presume, that, previous to this date, the remaining four are in the same predicament. The land, on which these lambs have acquired their morbid taint, has nothing in its quality to account for such effect; they had been accustomed to graze there before the arrival of the ewes from Lord Anson; and so had occasionally all the flock, with perfect and continued security.

I am aware that the most useful communication that can be made, in reference to this dirty and troublesome disease, will be whatever may embrace a successful

method of cure. Therefore, though I don't know that the plan I have adopted is superior in efficacy to that pursued by others, yet, as I have never met with a case of the disease, in any one of my sheep, that has not been cured by the means employed, it may not be useless to instance the treatment. This has hitherto consisted, first, in cleansing the feet perfectly with soap and water; then, in scraping with a knife, and occasionally cutting off the foul and putrid portion of the foot, whether of the interior softer parts, or of the hoof. After this, I scour all the surfaces (now besmeared with a bloody sanies) with a mixture of muriated antimony, tincture of benzoin, and tincture of myrrh, equal parts each; and then apply, with a hair pencil, to the more ragged and diseased parts, if such have escaped the knife, a little muriated antimony, alone. Even if such parts are not very discernible, I would recommend a slight wash of muriated antimony, to be passed over the surfaces which have been previously scoured with the mixture just described. Occasionally I have confined my sheep, when under this disease, for two or three days and nights, in a covered building, and sprinkled the floor thinly with quick lime. I object to the practice of muffling their feet, for the purpose of preserving them dry; because, if the land is wet, when they are so shod or turned out, (the substance used being commonly linen) the feet will suffer more from absorbed damp, than if they were not shod at all; and if the land is not wet, the practice is useless. Very strong leathern shoes, such as never will be provided for a flock of sheep, might, perhaps, for a short time ensure dryness; but it is much cheaper and more practicable to supply them, in obstinate cases, with board and dry lodging under an appropriate shed, or in some convenient out-house. At all events, they should be kept on dry treading for an hour or two after every dressing of the feet. I believe the practice here described will always put a stop to the progress of the foot-rot.

The first symptom, indicative of the approach of the foot-rot, is a lameness of the animal. This commonly appears in one of the fore feet. If the disease is suffered to advance, all the feet become gradually affected. When a sheep is examined in the incipient state of the malady, just as it begins to limp, no morbid appearance will be observed in the foot; but, on carefully handling the part, an increase of heat will be sensibly perceived, extending from the foot upwards to the joint of the knee. In a few days, white fleshy elevations will be found between the claws, and about the coronet of the hoof. A separarion of the interior softer

parts, from the hoof or shell, soon begins to take place, and all the diseased parts hasten rapidly to putrefaction, accompanied with a most offensive smell. This putrid effluvia, so peculiar in its kind, I consider as diagnostic of the foot-rot; the disease never exists without it after the first six days or week of its accession, as far as I have observed it. The appearances of inflammation, in or around the foot, are extremely slight; but a very small quantity of proper purulent matter, or what assumes that character, is sometimes formed. The disease destroys the horny shell or hoof, together with the interior substance. It is virulently infectious.

No. XIV.

On Irrigation; Claim for Premium. By Mr. Edward Beck, *of West Lexham, in the County of Norfolk.*

West Lexham, January 16th, 1807.

We, whose names are hereunto subscribed, do certify, that in the county of Norfolk, irrigation is not generally in practice; that Mr. Edward Beck of West Lexham, has, in the year 1806, watered twenty-one acres of meadow in the completest manner, viz. partly by catch-work, but mostly by beds raised in the middle, to the height of about two feet above the catch drains: that the whole was laid out by one of the most able irrigators in the kingdom, Mr. Smith. That the expense was upon an average twenty-eight pounds per acre. That the land in its old state was a bog, not worth more than from five to ten shillings per acre; and that in the present state of the land, it produced last summer, upon the part which was finished in time, from one and a half to two tons of hay per acre. After mowing, it was fed with sheep, at the rate of eight per acre, from July 18th until the 28th of October, when it was put in order for winter watering. About seven acres of the above was not begun to be formed before the first day of March; and though a bed of rushes, yet by means of the breast plough, the flag was preserved, and it produced a crop of hay, which was mown in July, and amounted to a ton per acre: these seven acres were then stocked with half-bred fatting sheep, at the rate of eight per acre; they fattened remarkably well, and are now going to market.

The above statement we certify to the Honourable the Board of Agriculture to be true; and that these twenty-one acres of watered meadows, are in addition to those for which the Board voted a premium to Mr. Edward Beck.

St. John Priest, Secretary to the Norfolk Agricultural Society.
William Kirbell, Farmer, East Lexham.
Robert Overman, Farmer, Burnham.

No. XV.

On Irrigation ; Claim for Premium. By Mr. Edward Beck.

West Lexham, January 8, 1808.

We, whose names are hereunto annexed, do certify to the Honourable Board of Agriculture, that Mr. Edward Beck did, in the last year, irrigate in this county of Norfolk, where irrigation is not in general practice, at least sixteen acres of land, which in its original state was an entire bog, and but little of it valuable for any purpose but cutting turf to burn: the cost of which was thirty-five pounds per acre. This was begun in March, 1807, and from its boggy state did not produce any feed, but was covered with rushes. By taking off the springs, the land is now become solid, and promises a good spring feed, and a crop of hay of good quality. The greater part of this is laid into parallel beds, with about two feet fall, having the floating gutters upon the crowns of the beds; the remainder is catch-work, watered by springs which rise in the meadow, and in the original state of it rendered useless.

St. John Priest, Secretary to the Norfolk Agricultural Society.
Levi Walton, Assistant to the Rev. St. John Priest, in surveying and delineating the Water Meadows at Lexham.

Mr. Edward Beck, *to the Right Honourable Sir* John Sinclair, *Bart. President of the Board of Agriculture.*

Sir, *Lexham, May 7th,* 1810.

Herewith I send you some particulars respecting my water meadows,—my thrashing machine, and heaver oats. The whole of which will, I humbly hope, prove satisfactory; and if I can give you any further information on those or any other subjects, I shall have great pleasure in so doing.

The bad state of the lands induced me to improve them by irrigation; they were not worth five shillings per acre in their original state. They were executed under the direction of Mr. W. Smith; the expence per acre 30*l*.

I begin to water them the latter end of October, and continue the watering 'till February; then if any fine days, the water is taken off, and put on again in the evening: indeed the principle is, that, whenever the air is warmer than the water, the latter is taken off. I begin feeding them about the 10th of March quite close, then water them again, and feed them 'till about the 10th of May, when they are (after being watered two or three days) shut up for mowing in six or seven weeks. They produce on an average two tons and a half of good hay per acre. After the hay is off they are watered again, and fed with fatting sheep, cows, and young cattle: I don't put on any other than fatting sheep, as there is no doubt of their rotting if watered after the hay is off; but in feeding them in the spring they are perfectly safe, and very healthy for sheep of every description. The hay is good for cows, producing much milk. I have fed my breeding ewes with it frequently, and they do well, which enables me to manure my arable land to much advantage. I calculate that an acre of water meadow, produces in every way manure sufficient for an acre of arable. To the queries respecting the rent or per centage of land thus improved, I find some difficulty in answering, as there may be local circumstances intervene to make them of more or less value; for instance, if mine were situated in the vicinity of London, they would be of much more value; and of less, if I had a proportion of pasture land on my farm, or if my arable land required less manure; but after my experience of the convenience, as well as of the profit, I would readily give a rent of five guineas per acre, rather than be without them. As to the per centage, I should hope no gentleman would wish for more than a net five per cent. for his money in the first instance; because I do think, that the turn of the scale should be given to the tenant for the first lease. I must here take leave to observe, that upon the plan of five per cent. and a 21 year's lease, I am of opinion that many hundreds, I might say thousands of acres would soon be irrigated in this county. I shall not attempt any thing like panegyric on my best of landlords, but merely state, that he not only gave me a 21 year's lease, but renewed it after I had completed my meadows, and seven years of the original lease had expired after this, and every other encouragement that could be given to a tenant. I hope it will not be too much for me to say, that if Mr. Coke's example as a landlord was followed, this county would soon, comparatively speaking, become a garden. To the remaining queries, as to the importance of irrigation to Norfolk, and how many acres would be so improved:—To

the first, I hvae no hesitation in saying, it is of the first importance, and by far the most valuable improvement that has been introduced in this county. As to the latter, I cannot speak with any degree of certainty, but I should suppose many thousands of acres; certainly there is no county in the kingdom where meadow land is less improved, nor any where it is more wanted.

My thrashing mill was made by Mr. Cook, of Swanton Abbots, Norfolk. It thrashes every kind of grain well, and separates the corn from the straw; it is worked with four horses; cost 125 guineas: I have had it three years; it has never been materially out of order, nor cost twenty shillings repairing since I have had it. There is no doubt of its being the best and most useful of any yet erected in this county.

The beaver oats I sow on my black sandy land; any other grain sown as a full crop on that land, would be what we call *blind*, that is, straw without corn. I last year tried a third of barley sown with them, one bushel of barley to three of oats per acre: it answered extremely, and makes good horse corn; nor did I find any inconvenience in the harvesting them.

Right Hon. Sir John Sinclair, Bart.
President of the Board of Agriculture.

No. XVI.

On Irrigation; Claim for Premium. By Mr. Thomas Purdy, *of Castle-Acre, in the County of Norfolk.*

To the President of the Board of Agriculture.

Sir,

As I am now watering at least twenty acres, in a most complete manner, by forming them into beds of from ten to twelve yards breadth, and introducing the water upon the crowns of the beds, to be carried off by parallel drains, I beg leave to submit them to your Honourable Board, in claim of the premium (No. XIV.) offered by the Board for irrigation. I desire to state, what will appear in the enclosed sealed letter, verified by certificates, that the meadows I am irrigating, are situated in a neighbourhood which consists almost entirely of arable land, let generally for not more than from ten to eighteen shillings per acre per annum.

That meadow and pasture land do not bear a greater proporton, than of one acre to fifty of arable land; and, that notwithstanding this great want of feeding land, yet, the meadows which I am irrigating, were not in their old previous state, worth more than seven shillings per acre to let, being two thirds of it boggy, and the remainder full of sedges, and all sorts of aquatic rubbish.

In the present state, and with the prospect of future advantages to be gained by this irrigation, a neighbouring farmer has already offered me, to hire the whole of these meadows for any length of time, and to give me for such hire five guineas per acre per annum, not doubting but they will produce in the first crop of hay next summer, at least two tons and a half per acre.

The method I have taken to irrigate the above meadows is, by taking water out of its natural course, at the distance of at least thirteen chains above my first meadow, by a ditch upon the average twenty feet wide, seven feet perpendicularly deep, and six feet wide at the bottom. The water thus introduced, divides itself into two feeders, one of which conveys water to my first meadow, and then runs off to

water my last meadow, and the other to the other intermediate meadows. All the meadows are formed into beds, as I have stated above, which are raised so as to have a fall on each side from two to three feet, and so well formed, as to be watered in every part. The work is all done by labourers with spades, and will cost altogether about 30*l.* per acre. This expense, however, I think by no means considerable, when I take into consideration the circumstances of value above stated, and when I consider, what perhaps may not occur in those countries where irrigation is more practised; viz. that the turnip crop, as food in winter, is becoming more expensive and (what is of great consequence) more precarious; to supply which deficiency, I expect the hay of these water meadows to be such a resource, as is almost inestimable.

Referring to the certificates enclosed for the truth of the above account, I subscribe myself, according to the conditions pointed out by your Honourable Board,

your most obedient servant,

A. B.

Castle-Acre, January 11th, 1810.

We, whose names are hereunto subscribed, desire to state to Sir John Sinclair, President of the Board of Agriculture, and the Members of that Honourable Board, that we have examined the meadows, now irrigating at Castle-acre, by Mr. Thomas Purdy, farmer in that parish, and have read the letter signed A. B. which accompanies this certificate; and desire to assure you, that we agree with what is stated in it; and we think it right to add, that great stress ought to be laid on the value, that is attached to any meadows or pasture land, and particularly to water meadows, in such a neighbourhood as this, where not only the turnip crop is becoming yearly more expensive and more precarious, but our artificial grasses, upon which, for want of natural grasses, we used to rely, are now (from what cause it is needless to state), becoming less and less productive.

St. John Priest, Secretary to the Norfolk Agricultural Society.
Thomas Hendle, farmer, East Lexham.
William Kirbell, farmer, East Lexham, near Castle-acre.

No. XVII.

Account of Twenty-five Acres and a half of Grass Land irrigated in 1806 *and* 1807, *part in catch-work, and part in beds; and then worth Forty Shillings per Acre per annum. By* Francis Hale Rigby, Esq. *Mistley Hall, Manningtree, Essex.*

	£.	s.	d.		£.	s.	d.
Prime cost of making 25 acres and half of water meadow - - -	464	15	8½	April 4th, turned in 316 ewes and lambs till the 10th May, worth 1*l.* per score per week - -	79	0	0
Labour and repairs from 1st November 1808 to 1st November 1809, when the meadow was shut up -	24	6	0	Produce of crop of hay the end of June two tons per acre, worth, and sold at, 6*l.* 16*s.* 6*d.* per ton -	348	1	6
				Shut up for a second crop, which in September produced one ton and a half per acre, at 3*l.* 10*s.* per ton	133	17	6
				Value of manure saved, and carried on to other land, eleven loads per acre at 7*s.* per load - -	98	3	6
	489	2	8½		659	2	6

FRANCIS HALE RIGBY.

I do hereby certify the above account to be accurate, the expenditures in forming and completing the irrigation having been made within my own knowledge, and the produce, in quantity, and disposition, as above stated.

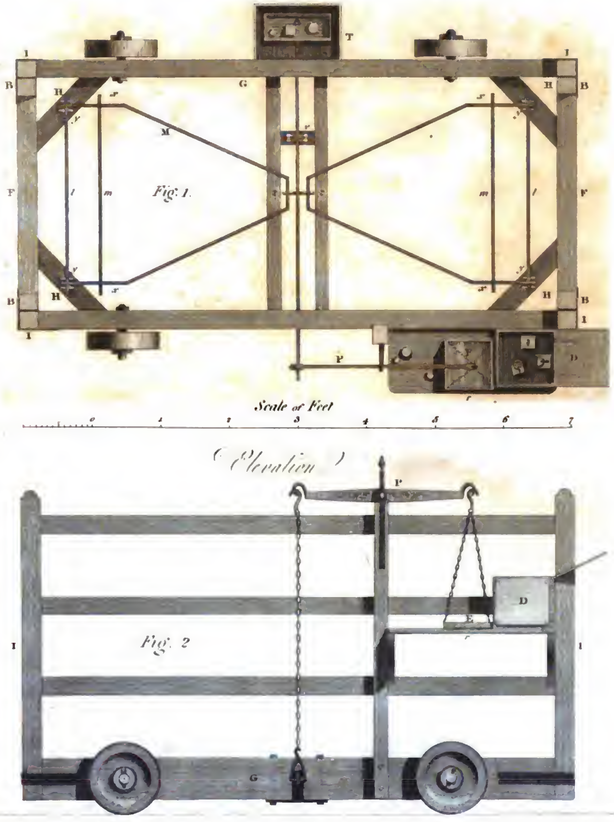
JOHN AMBROSE.

Mistley, 15th December, 1809.

Communicated to the Bd. of Agriculture Vol. III p. …

Plate I

Ground Plan of Mr. Shepherd's Machine for Weighing Live Cattle!

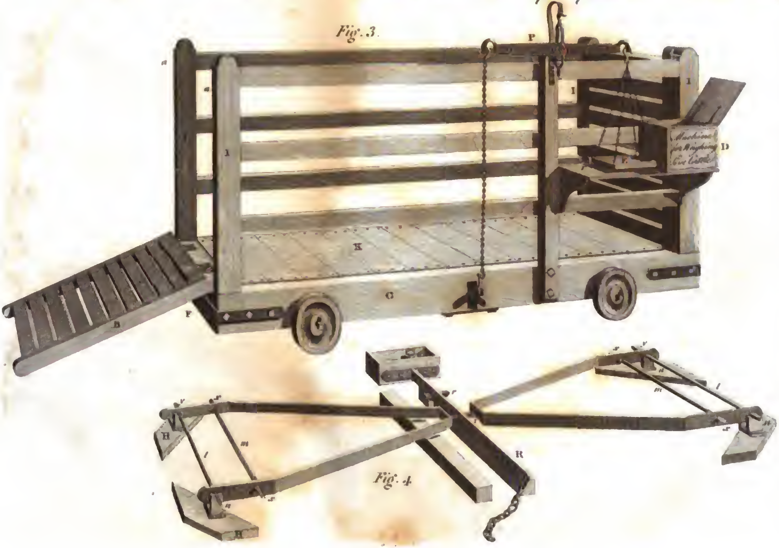


J. Farey Junr. delt.

Neele sculp. Strand

Plate II.

A Perspective View of M^r. Shepherd's Machine for Weighing Live Cattle.



J. Farey Jun.^r del.^t

Neele sculp. Strand.

No. XVIII.

Description of Mr. Shepherd's Machine for weighing Live Cattle.

THE principal advantages of this machine are its portability, the ease with which the animals can be induced to enter it, and that they are kept in the proper place during the operation of determining their weight, without difficulty, as the operation is not of such an appearance as to give the animal any alarm.

Plate I. contains geometrical drawings of the machine, and its various dimensions may be ascertained by a reference to the scale of feet annexed; in the next Plate the machine is exhibited in perspective, and its parts are explained more minutely, but in all the figures, the same letters denote the same parts as far as they will apply. FF, GG, figs. 1, 2, and 3, represent a strong frame of wood, braced at the angles within-side, by the pieces H, fig. 1 and 4, and strengthened by iron straps on the outside, as shown at figs. 2 and 3. IIII are 4 posts erected from the angles of the frame, to support the railing on each side of the machine: these are intended to keep the animal upon the weigh bridge K, fig. 3, which is the floor of the enclosure, formed by the side and end railing; the latter, marked BB, are connected with the frame, by hinges at their lower sides, so that they can be let down, in the manner one of them is represented in fig. 3; in this position, it forms a bridge for the animal to ascend the weigh-bridge K, without the smallest difficulty, though the bridge is raised from the ground a sufficient height to admit of the mechanism being placed beneath it, and consequently defended by this means from the danger of accidental violence. When the ends B are placed upright, they are retained in that position by hooks, *a a*, screwed to the vertical posts II.

The weigh-bridge K, upon which the animal stands when in the machine, is not connected with the framing of the machine, but is left with a trifling clearance all round, as seen in fig. 3; it is supported on levers marked M fig. 1, in the plan, (where the weigh-bridge is removed, to exhibit them,) and shown in a detached state in fig. 4: these levers are formed of iron bars, placed edgeways upwards, to give

them greater strength. L is an iron bar, fastened to one end of each of the levers, and connecting the two bars MM; it is formed to sharp edges in the lower side at its ends, and upon these edges the large end of each lever rests, forming the fulcrum; the support is a small cast-iron frame *n*, fig 4, screwed down upon the angle braces H of the main frame; at *m* another iron rod is fixed across each of the levers; its upper sides are filed to a sharp edge to receive small iron standards, exactly similar to *n*, fixed beneath the weigh-board: in this manner the board rests upon four points of bearing, two for each lever, as shewn by x x x x in the plan, fig. 1. Now it is evident, that any weight placed on the weigh-board will press down the levers on their centres or fulcrum at y y y y, and cause a depression of their extreme ends z z; at these ends the weight is balanced by means of another lever R, moving on a fulcrum at *r*, and supporting the ends of the great levers, by a projecting piece of iron z z, filed to a sharp edge on the upper side, to avoid any sensible friction. The ends of the levers R project through the side beam of the great frame; at one end it has a box A, fig. 1, fastened to it, and the other is connected by a chain with a scale beam P, suspended from an iron brace, screwed to an upright post of the side railing: from the opposite end of the scale beam, the scale E is suspended, to receive the weights; the scale hangs over a shelf *r*, which supports the box D, containing the weights when not in use; the principal of these are as follows; four answering to 448lbs. or 56 stone; two of 224lbs. or 28 stone, being half the former; two of 112lbs. or 14 stone, and a great number of smaller weights for the subdivision of the former; by the assemblage of all these weights upwards of 300 stones, or 2400lbs. can be weighed, though the real weights do not exceed 90lbs. This difference between the real weighis, and what they will balance, depends upon the same principle as the steelyard, the machine being, in fact, a combination of two steelyards, first in the great levers the weight on the weigh-board acts at *x* 6 inches from the fulcrum *y*, these levers act upon R, at the point z, which is $38\frac{1}{2}$ inches from the fulcrum, consequently a weight of $4\frac{1}{4}$ pounds applied at the point z will counterbalance $27\frac{1}{4}$lbs. nearly, placed upon the weigh-board; again, as the point z is $9\frac{1}{2}$ inches from the centre *r* of R, whilst the point where it acts upon the scale beam is $40\frac{1}{2}$ inches from the centre *r*, therefore one pound placed in the scale will balance $4\frac{1}{2}$ at z, or $27\frac{1}{4}$ pounds upon the weigh-bridge; and in the same proportion for any other weight. The weight of the bridge, the levers, &c. is balanced by weights placed in the box A, attached to the lever R; this is enclosed in a box T,

furnished with a lock, to prevent any wilful or careless disturbance to the action of the machine, which might happen from this balance box being exposed.

It will, however, be proper to examine if the scale balances truly when the machine is at rest, every time before it is used, because the gradual accumulation of dirt upon the weigh-bridge, the board imbibing moisture, or other causes, may prevent the balance being correct, and consequently the machine weighing accurately: if it should be found deranged, the dirt must be removed from the board, and if this is not sufficient, a small stone or other trifling weight thrown into the box, will restore the equilibrium.

In using the machine, it will be most convenient to place it in the gateway of the farm-yard, where all the beasts to be weighed are first shut up, the end B towards the yard being let down, and the opposite one shut up, in the manner shewn in fig. 3, Plate 2; the animal is driven into the machine; as soon as he arrives upon the weigh-bridge, the other end is turned up and hooked fast: he is now weighed, by placing such weights in the scale E, as will bring the scale beam to a true balance; and as soon as this is done, the other end B is let down, and the beast walks forwards out of the yard, and is by this means prevented from joining the other beasts which have not been weighed. By this arrangement it will be seen, that a large herd of cattle may be accurately weighed in a short time, as no other attention is necessary in weighing each individual, than to see that he stands fairly upon the weigh-bridge without resting against the rail.

To insist upon the use of such a machine to the farmer, will be unnecessary; he will be able to determine with accuracy the improvement of his cattle, upon different food, and to judge without difficulty of their value in the market.

In fairs and publick markets, the utility of the weighing machine appears in a still more striking light; the farmer, by knowing the actual weight of his beast, will be placed more on an equality with the butcher in his dealings; at present, the latter, having constant opportunities of knowing the weight of the animals when slaughtered, is able to form, at first sight, a much more correct judgment of their value, than the farmer, who meets but few opportunities of determining the real value of the article, upon which his business so greatly depends.

No. XIX.

The Barberry-bush an Enemy to Winter Corn, proved by Observations, Experiments, and Testimonies. By L. E. Windt, *Counsellor in the Chamber of Accounts of the Count Le Lippe Schaumberg*, 1806. *Translated for the Right Hon.* Sir Joseph Banks, *by the Secretary of the Board.*

The following hints were collected in consequence of the author's situation, as entrusted with the immediate management of several demeans, of whose condition, in important particulars, he had to make a report to the Seigneureal Chamber, from which general orders issued.

I KNEW not that certain plants in its neighbourhood, could occasion this injury to corn, when the tenants of Evesen came forward, accusing universally as its cause, the new trees and shrubs lately planted in the English garden of Kluss;* while a few particularly blamed the barberry; observing, that before the introduction of that plant, the mildew was rare, whereas it now constantly prevailed. The great garden at Hockersau was, above eight years ago, hedged with barberry, on the side looking to the ground called "*die breite vor dem hofe.*" This ground, whenever sown with rye, has suffered by mildew, more particularly since its partition two years ago, to the enormous loss of the tenants. Of late years, the evil has extended to the neighbouring fields, called "*die Abtheilung;*" then southward to the field called "*Horst*" belonging to the ground of Evesen, and then farther on to *Pezer hofen*,† in which the mischief was less considerable. Contiguous to the barberry hedge, are four alleys of fruit trees. Two of these alleys, farmer W. sowed this year with rye, which appeared to be in a perishing state. I visited this rye with the superintendant, Mr. Gerike, of Heimde‡. That next to the hedge was in ear, but

* It lies near the farm Hockersau, on the road to Minden.

† Fields distant 200, 800, and 1000 paces from the hedge.

‡ Author of the Practical Introduction to Rural Economy, and of the important Treatise on the Staggers in Sheep, and the Mode of curing it.

the ears were empty; the stems and blades were dry and white; the stems were for the most broken, so that the heads hung entangled with each other. In the adjoining field the corn was shrivelled, but fewer stalks were broken, and these also were higher than the rye contiguous to the hedge. I showed these appearances to Mr. G., who had the goodness to accompany me to the fields in question, after farmer W. had moved the shrivelled rye. The swathes next to the hedge looked like chopped straw; those farther off were less broken; but even in the divisions considerably remote, the rye was observed to look red, or yellow. In the field called Horst,* the rye was much injured on the side looking to Hockersau: at a distance from Hockersau it was injured less; the division most remote was not hurt at all. The complaints of mildew in this district have begun within these last 6 or 8 years, and have continually grown stronger: a cause therefore must exist for the evil now, in places where it did not formerly prevail. That this cause is the barberry, the peasants, from a fixed period, began to suspect. *Aldag*, living in the Evesen district, No. 1, and neighbouring farmers, told me, that at the sale of the stock of Hockersau, a stranger had said to the weaver M., who lives at Barrenbush, that the hedges about the garden had injured the corn.

Before Barberries were placed in the garden of Kluss, mildew seldom occurred in the neighbouring fields; since that time it has prevailed yearly, more or less. From my own observation, I can affirm that the evil has increased for 6 years, from year to year: in farmer W.'s ground, the havoc is such at present, that nothing like to it is remembered. This is what might be expected, if the barberry is in fault. The evil has increased, as the hedge, which was at first weak, by degrees gained strength.

Barberries were planted years ago in the Seigneureal garden. For the last six years, that is, during the time I have been here, the rye on the adjacent *Hofbreite*, as it is called, has constantly suffered much by rust. At the further end of this field, there is rye considerably distant from the garden. This also is mildewed. A like injury is observed in the *Bargerfield* opposite to the garden.

An enclosure had been made with this plant, round a field of beans; the beans were ruined by mildew; the hedge was removed, and the evil ceased.

* Horst belongs to the Evesen district, an excellent soil, where the best corn formerly wont to grow.

The barberry in this neighbourhood is covered, every year, on the leaves and fruit, with rust. In other places, I have seen it flourishing in healthful luxuriancy.

The thing that I learned to day (20th July, 1804) of most importance to my inquiry, was the following. I walked along the hedge enclosing H.'s field, between the hedge and the rye. The shepherd's son had said, that here no Barberries were to be found, I therefore passed forward, careless of the hedge, and looking only at the corn. At once I saw before me, rye in as bad condition as at Hockersau close to the barberry hedge: white, dry, the ears shrivelled, and the stems broken. It lay in a half circle of six paces in semi-diameter, from the main stock of the hedge. It seemed as if it had been beaten down with a club. This appearance, which very much surprised me, turned my attention to the hedge, where I immediately discovered a barberry-bush to be the source of the evil. I advanced straight forward, amid the corn, and found, even where the stems were upright, the ears quite shrivelled, and the mischief extending deeply into the field. This striking observation concurred with what is before said of F's. field, where the mildew in the rye increased with its vicinity to the barberry, to assure me that this plant, at least in our climate, has the most pernicious effect.

Towards the end of Oct. 1804, I caused eight of the soundest barberry-bushes, bearing fruit, to be brought from Hockersau, and transplanted in the Petzerfield, well besmeared with slime at the roots, to invigorate the vegetation. Two of them were placed near the rye, 40 steps asunder. A third was planted by mistake among wheat. At the distance of 800 steps from these three, the five others were planted among rye, distant 50 steps, respectively, from each other. It was scarcely possible, that an experiment made on so large a scale, should not afford conviction. To me, who was convinced already, it seemed grievous to destroy much good grain, but the present loss, I hoped, would be over-balanced by future advantage.

On the 4th of July, I found, on examination, that the rye had begun to suffer from the dangerous neighbourhood. The evil has recently so much increased, that the rye is now quite ruined, as the Chamber will be convinced by the accompanying samples. The effect is the more striking, because the corn a little inward, continued perfectly sound.

Maschoorwerk, 8th July, 1805,
Stahlnuth.

The result of this experiment was as decisive as can be conceived; wherever the barberry bushes were planted, the rye was mildewed, and in proportion to the proximity to the bushes, and the prevalency of the wind; but the evil did not extend to so great a distance as in a neighbouring field, where barberries grew in their full vigour, without transplantation; in those parts of the same fields where no barberries stood, the rye escaped the mildew, and produced a sound crop. This report was signed by various persons, and transmitted to the Chamber.

I viewed two small patches of rye, contiguous to the Harl Bosquet, from which they receded in a sloping direction. The upper end of the field was about 15 paces from the Barberry, but separated from it by a hedge and various bushes; yet was it totally destroyed by rust. The damage had been done after the grain had nearly attained its full growth. It will fall short in the measure by more than three-fourths, all the grain being unripe, dry, light, containing little, and that very bad meal. Downwards the rust diminished, and at the lower end of the field, about 100 paces off, there was not the smallest vestige of it to be discovered; the grain might be pronounced perfectly sound.

I have moreover to remark, that neither the rye, nor the wheat, viewed by me this summer, was in the least mildewed, unless standing in the neighbourhood of barberries. The weather has, by itself, been no where able to produce this malady. The crops will be middling in quantity, but consist of sound grain.

In order the better to convince myself upon this interesting point, I ordered some boxes to be made so as to be introduced under some growing rye, which was late sown, and to take up the crop to the space of a square foot, without the least injury to the plants, in such manner as to be moveable to any place where I wished to fix them; the rye was just ready to bloom: one box was fixed close to a barberry bush: at the distance of 100 paces another box was fixed; and at half that distance, on the other side of the bush, a third: this last had begun to ear, and wanted only 14 days of being ripe. This was done on the 13th of July. On the 15th, the rye in the boxes was so much mildewed, as to threaten, in the opinion of the peasants, a considerable loss in the crop. At this time there was some appearance of mildew in the field, from which the rye in the boxes had been taken; but much less than what was found on the latter.*

* The account is so confused from running immediately into other fields, and circumstances, that the comparison cannot be clearly ascertained at this period.

From careful observation it appears, that barberry bushes affect rye at every distance, as far as 1000 paces, and in some cases yet farther.

It is found that dry elevated grounds seldom suffer by mildew or rust, even when the wet and low-lying are attacked by it.

The Chamber of Accounts, taking all this into serious consideration, declared that the question was decided, as clearly as the nature of the thing admitted, or as practical purposes required. Accordingly, the matter was laid before Government, and a general order issued: I. That all barberry bushes should be rooted out from hedges, gardens, fields, or plantations near fields, before the 1st December, 1805. II. That persons contravening this order should be fined two dollars. III. That the fines should be bestowed in rewards to informers. By these means the barberry has been extirpated from the district of Buckeburg, where it formerly abounded; or if any lurks concealed here, or in other parts of the country, it will certainly not be able to defend itself against the zeal and avidity of informers.

This preliminary information I have laid before the Count's Chamber, humbly wishing to be instructed whether the barberry hedges, at all events, should be rooted out next harvest, and a different kind of hedge planted. If suspicions are confirmed by future experiments, it will be necessary, for the benefit of Agriculture, to root out the barberry, not only from the Bosquet, or English garden, abovementioned, but also from the Seigneureal gardens.

Buckeburg, 8th July, 1804.

Prussian Bailiwick of House-berge. Meyer, Bussing, Edler, intelligent farmers, appeared before the tribunal of this district, and declared their knowledge, from long experience, of the mischief occasioned by barberries to rye, which had induced them to extirpate these bushes.

Signed 20th July, 1804.

Another deposition to the same purpose, by Johann Hendrich Mohme, in the same month.

In consequence of these and other documents, Mr. Windt received orders to grub up a barberry hedge at Hockersau, 1500 feet long.

In another document is the declaration of a steward, who grubed up a barberry

hedge at the instigation of the peasants, because it had for many years been injurious to their rye in causing the mildew; but the corn continued to be mildewed after the destruction of the hedge.

From the Imperial Intelligencer, No. 26, 1805. *Injury from Barberries near Potsdam.*

Six barberry bushes had a considerable effect in mildewing a field of rye, in the year 1800, so partially, as to leave no doubt of the cause of the malady.

Nearly adjoining to the preceding field, seven barberry bushes stood 80 paces from a field of rye, and the crop was grealy damaged, even to the distance of 1000 paces; and the discoloration spread in the shape a fan from each bush, evidently caused by the wind. There was a piece of wheat, at the distance of 1000 paces, which escaped without injury; but the plants of rye, which grew amongst it, were considerably damaged.

Similar observations were made in 1798 and 1799; and it is remarked, that the peasants had for many years complained of the mischief done to their corn by barberry bushes.

Similar observations have been made in Lusatia.

It was expected that the mildewed straw would have disagreed with the cattle that ate it, but the event proved otherwise.

In No. 36, of the same work, is a communication from Mr. Von Reller, near Wurzen, describing a very fertile field which had always produced healthy grain, but barberry bushes having been planted in its vicinity, when they grew up, they affected the rye so much, as, in 1801, &c., nearly to destroy the crop; but spring corn escaped: he found that the interposition of a wall 15 feet high yielded no security.

In No. 213, there is an account, by the Professor of Botany, Mr. Sprengel, of Sir Joseph Banks's Dissertation on the Mildew, expressed in terms of the highest commendation.

From the Hanoverian Magazine, 1805.

In this work there are some traces of similar remarks, but they are not registered with equal attention. And it also contains something in support of a contrary

opinion: the case of a district, in which the barberry is condemned by the country people, as being injurious to fruit trees, particularly those bearing stone fruit, and plum-trees dropping an untimely crop, occasioned by the vicinity of these bushes, without any complaint of injury to corn.

A similar observation also was made near Gottengen.

The superintendant Straklhuth told me, that he had seen rye contiguous to certain places in hedges, where there were no barberries, as completely ruined by mildew, as if they had stood in the dangerous neighbourhood of that plant. I had long thought that there might be many shrubs of a deleterious quality to corn, by the discovery of which much mischief would be prevented. I therefore requested Mr. S. to find out what sort of plants grew in those pestiferous places, and to bring me specimens of their leaves and branches. He brought me a twig of the *Cornus sanguinea;* the leaves were all of them diseased, as the leaves of plum trees are, when attacked with what is called the honey dew, through which malady they appear as if sprinkled here and there with powder. By the microscope I could not discover any mushrooms, but each blade was a microcosm of little animalcules, that seemed to crawl amidst mountains of dead bones. These seeming bones gave to the leaves their powdery appearance, and were nothing but the upper skins of the wonderfully small winged leaf lice, which these insects cast, as do the *bost** and *augst.*† The animalcules on the cornel were these small leaf lice of a green colour. In a fold of the leaf I found a small snail, of the length of the leaf lice, but remarkably slender, and differently shaped from the snails I remember to have formerly seen on diseased barberry leaves, crawling on the hedge of the mushrooms above mentioned.

This article I have thought fit to insert, that farmers may pursue the hint, and investigate other plants whose growth may be hurtful to grain. This may easily be done in walking along a hedge in July, which has rye, or corn fields opposite to it.

I conclude this paper in the persuasion, that the point which I aimed at is established, and that in this matter, how unimportant soever my labours, I have at least done my duty. To those still inclined to regard the barberry as innocent, not-

* *Hemerobuis ephemerius;* the fly living but one day described by Swammerdam.

† Described in the Hanoverian Collection, year 1752, No. 62, p. 785.

withstanding all the above proofs to the contrary, I would only make the request, that they no longer urge their opinion on abstract and general grounds, until they have collected the result of impartial observation and careful experiment. To be convinced by their own eyes, let them plant barberries among rye, and compare their effect with that of hazel or horn-bean: towards the end of June let them cut off a few barberry branches with their leaves, some of which branches are infected with rust, and others in a sound state; let them be respectively scattered in different places among the corn, and the consequences carefully remarked. Justice requires, not only that such experiments should, by every man, be confined to his own possessions, but that, for the safety of his neighbour, the deleterious vegetables should be destroyed, as soon as their operation has been ascertained.

The botanists and agriculturists of Germany would much enhance their merit with the public, by settling this point definitively. To them properly it belongs to follow up the inquiry, by examining whether there are not other hedge-plants of a prejudicial influence on grain; in which view, the *Cornus sanguinea* particularly deserves their attention.* A way may be thus gained for investigating the causes of various other diseases in grain; particularly the rust or blight, now so common, may be so much checked in future, that it will be regarded as a phenomenon.

The barberry bush is found very frequently in Germany, but by no means universally. On the supposition that it grows but very dispersedly, and that, according Sir Joseph Banks's opinion, the seeds of its fungi, occasioning the blight, float for miles around in the air,—it is probable that the damage done by it, in these northern parts of Germany, exceeds half a million of dollars annually. This is an object deserving the attention of the Prince's chamber, and territorial jurisdictions. The poor peasant must often, unhappily, be compelled into measures calculated to promote his own immediate benefit. Useful discoveries in Agriculture pass unheeded by him, who, blinded by prejudice, or crippled by indolence, is always inclined to leave all matters on the old footing. If his land consists chiefly in garden ground, or in meadows, why should he submit to trouble and expense, that corn-crops may be augmented? Nothing short of the authority of Government, dispensing rewards and punishment, and seconded by the diligence of those who

* September, 1805.

are entrusted with magistracy, in different districts of the country, can prove sufficient to extirpate the barberry so completely, that no mischievous vestige of it shall remain in our fields. I flatter myself that, as my representations, fortified by the proofs in this work, have prevailed with the government of my country, to issue a general order on the subject, they will not pass unregarded in neighbouring states; and that in the course of a few years the barberry, unless concealed in the obscurity of distant forests, will, in the northern parts of Germany, be as rare an object as the palm tree of the East.

No. XX.

On Waste Lands. Claim for Premium. By Charles Duncombe, *Esq. of Duncombe Park, Yorkshire.*

THE premium for the improvement of waste land, which the Board of Agriculture has so properly and so repeatedly offered, not having been hitherto noticed from any part of the kingdom, I beg to submit to the Board, the following statement of lands which are now brought under such a system of cultivation, that a general benefit will permanently result to the community, in as much as an increase of productive ground is reclaimed from its former state of waste, and the Board will have an opportunity of judging, whether the efforts to that effect are deserving of its reward. The pieces of ground reclaimed are in different farms, and possibly the particulars required by the Board, may not be so minutely preserved as might be desired; but sufficient will appear to shew what individual efforts may produce towards that most desirable object,—the raising within these dominions sufficient grain for their own consumption, and thereby rendering them independent of foreign countries, for the supplies necessary to the support of their increasing population.

C. DUNCOMBE.

1810. *Account of the Cultivation, Expense, and Produce of Waste Land in the Township of Farndale, and Parish of Kirbymoorside, in the Occupation of* Charles Duncombe, *Esq. Previous to being broken up, the Surface was covered with large stones, and with brackens, and rushes, and lying on the side of a steep Hill in a Valley in the Moors.*

No. I. contains 4 Acres 3 Roods.

How cultivated.	Expenses.	£.	s.	d.	Produce.
1803.	1803.				
Pared and burnt, once ploughed, limed, and sown with rye.	Cutting and breaking stones at 3*l.* 10*s.* per acre	16	12	6	
	Carrying stones off the land - - - -	28	10	0	
	Draining 12 roods at 1*s.* 6*d* per rood -	0	18	0	
	Paring and burning, &c. at 1*l.* 2*s.* per acre -	5	4	6	
	Once ploughing at 1*l.* per acre - -	4	15	0	
	16 chaldrons of lime and leading at 1*l.* 2*s.* per chal.	17	12	0	
	Spreading ditto at 9*d.* per chaldron - -	0	12	0	
	10 bushels of seed rye at 5*s.* 6*d.* per bushel -	2	15	0	
	Sowing, harrowing, &c. at 3*s.* 6*d.* per acre -	0	16	7	
	To 25 rood of fence wall at 2*s.* 6*d* per rood -	3	2	6	
	Gates and incidental expenses - -	1	0	0	
		£. 81	18	1	
	1804.				1804.
	Corn reaping, carrying, stacking, &c. at 18*s.* per acre - - - -	4	5	6	14 bushels of rye per acre, 4a. 3r., 66½ bushels at 5*s.* per bushel. 16*l.* 12*s.* 6*d.*
	Thrashing 8qrs. 2bus. of rye at 4*s.* 6*d.* per quarter	1	17	0	
		£. 6	2	6	
1805.	1805.				1805.
Three times ploughed, three times harrowed, and sown with rape, which were eaten on the ground with sheep.	Three times ploughing and three times harrowing at 12*s.* per acre - -	8	11	0	Rape worth 2*l.* 5*s.* per acre, 4a. 3r., at 2*l.* 5*s.* per acre, 10*l.* 13*s.* 9*d.*
	Rape seed and sowing - - -	0	10	0	
		£. 9	1	0	
1806.	1806.				1806.
Once ploughed and harrowed, and sown with oats and seeds, viz. 10lb. of white clover, 2lb. of rib grass, 2lb. of trefoil, and 1 bushel of rye grass per acre.	Once ploughing and harrowing at 12*s.* per acre -	2	17	0	40 bushels of oats per acre, 4a. 3r., 190 bushels at 3*s.* 6*d.* per b. 33*l.* 5*s.*
	22 Bushels of seed oats at 3*s.* 6*d.* per bushel -	3	17	0	
	Corn reaping, carrying, stacking, &c. at 1*l.* per acre	4	15	0	
	Thrashing 23½ qrs. of oats at 1*s.* 2*d.* per qr. -	1	7	5	
		L 12	16	5	

1807, 1808, and 1809, has been pastured with sheep, and is now worth 17*s.* per acre.

No. II. contains 7 acres 1 rood 20 perches.

How cultivated.	Expenses.	L.	s.	d.	Produce.
1804.	1804.				
	Cutting and breaking stones at 3*l.* 10*s.* per acre	25	16	3	
	Carrying stones off the land - - - -	43	10	0	
	Draining 102 roods at 1*s.* 6*d.* per rood -	7	13	0	
Pared and burnt, once ploughed, limed, and sown with rye.	Paring and burning, &c. at 1*l.* 2*s.* per acre -	8	2	0	
	Once ploughing at 1*l.* per acre - - -	7	7	6	
	24 Chaldrons of lime and leading at 1*l.* 2*s.* per ch.	26	8	0	
	Spreading ditto at 9*d.* per chaldron - -	0	18	0	
	17 Bushels of seed rye at 6*s.* per bushel -	5	2	0	
	Sowing, harrowing, &c. at 3*s.* 6*d.* per acre -	1	5	9	
	To 56 roods of fence wall at 2*s.* 6*d.* per rood	7	0	0	
	Gates and incidental expenses - - - -	1	10	0	
		L. 134	12	6	
	1805.				1805.
	Corn reaping, carrying, stacking, &c. at 1*l.* 4*s.* per acre - - - - - -	8	17	0	32 Bushels of rye per acre, 7a. 1r. 20p., 236 bush. at 7*s.* per b. 82*l.* 12*s.* 0*d.*
	Thrashing 29½ qrs. of rye at 4*s.* 6*d.* per qr. -	6	12	9	
		L. 15	9	9	
1806.	1806.				1806.
Three times ploughed, and three times harrowed, and sown with turnips, which were eaten on the ground with sheep.	Three times ploughing and three times harrowing at 12*s.* per acre - - - - -	13	5	6	Turnips worth 3*l.* 10*s.* per acre, 7a. 1r. 20p. at 3*l.* 10*s.* per acre, 25*l.* 16*s.* 3*d.*
	Turnip seed and sowing - - - - -	0	15	0	
	Turnips hoeing at 7*s.* per acre - - - -	2	11	6	
		L. 16	12	0	
1807.	1807.				1807.
Once ploughed, harrowed, and sown with rape and seeds, about the same quantity of seeds sown per acre as in No. I.	Once ploughing and harrowing at 12*s.* per acre	4	8	6	Eaten slightly with sheep worth 1*l.* 10*s.* per acre, 7a. 1r. 20p. at 1*l.* 10*s.* per acre 11*l.* 1*s.* 3*d.*
	Rape-seed and sowing - - - - -	0	15	0	
		L. 5	3	6	

1808 and 1809, has been pastured with sheep, and is now worth 16*s.* per acre. It is to be observed the labour of clearing the above two pieces of ground of stones, was equal, but the draining of the former was in a much greater proportion to the quantity.

No. III. contains 4 acres, 3 roods, 36 perches.

How cultivated.	Expenses.	L.	s.	d.	Produce.
1805.	1805.	L.	s.	d.	
	Cutting and breaking stones, at 4*l.* 10*s.* per acre	22	7	6	
	Carrying stones off the land - -	32	8	0	
	Draining 114 roods, at 1*s.* 6*d.* per rood -	8	11	0	
	Paring and burning, &c. at 1*l.* 2*s.* 6*d.* per acre	5	12	0	
Pared and burnt, once ploughed, harrowed, limed, and sown with rye.	Once ploughing, at 1*l.* per acre - -	4	19	6	
	15 chal. of lime and leading, at 1*l.* 2*s.* per chal.	16	10	0	
	Spreading ditto, at 9*d.* per chaldron -	0	11	3	
	Eleven bushels of seed rye, at 7*s.* per bushel	3	17	0	
	Sowing, harrowing, &c. at 3*s.* 6*d.* per acre	0	17	3	
	To 50 roods of fence wall, at 2*s.* 6*d.* per rood	6	5	0	
	Gates and incidental expenses -	1	0	0	
		L. 102	18	6	
	1806.				1806.
	Corn reaping, carrying, stacking, &c. at 1*l.* 4*s.* per acre - - -	5	19	4	32 bushels of rye per acre. 4a. 3r. 36p.=159 bush. at 5*s.* 6*d.* per bushel,= 43*l.* 14*s.* 6*d.*
	Thrashing $19\frac{1}{2}$ quarters of rye, at 4*s.* 6*d.* per qr.	4	7	9	
		L. 10	7	1	
1807.	1807.				1807.
Three times ploughed, and three times harrowed, and sown with turnips, which were eaten on the ground with sheep.	Three times ploughing and three times harrowing, at 12*s* per acre - -	8	18	6	Turnips worth 3*l.* 15*s.* per acre. 4a. 3r. 36p. at 3*l.* 15*s.* per acre=18*l.* 13*s.*
	Turnip seed and sowing - -	0	9	6	
	Turnips hoeing, at 7*s.* per acre -	1	15	0	
		L. 11	3	0	
1808.	1808.				1808.
Once ploughed and harrowed, and sown with oats and seeds, same quantity of seeds as before.	Once ploughing and harrowing, at 12*s.* per acre	2	19	6	32 bushels of oats per acre. 4a. 3r. 36p.=159 bush. at 4*s.* 3*d.* per bushel= 33*l.* 15*s.* 9*d.*
	23 bushels of seed oats at 4*s.* 6*d.* per bushel	5	3	6	
	Corn reaping, stacking, carrying, &c. at 18*s.* per a.	4	9	6	
	Thrashing $19\frac{1}{2}$ quarters of oats, at 1*s.* 2*d.* per qr.	1	2	9	
		L. 13	15	3	

1809 has been pastured with sheep, and is now worth 14*s.* per acre.

The expenses in this piece run very high; 1*l.* more per acre being given for the stone work, and the draining being in the proportion of about 24 roods per acre.

No. IV. contains 5 acres, 2 roods.

How cultivated.	Expenses.	L.	s.	d.	Produce.
1806.	1806.				
Pared and burnt, once ploughed, harrowed, limed, and sown with rye.	Cutting and breaking stones, at 4*l.* per acre	22	0	0	
	Carrying stones off the land - -	33	0	0	
	Draining 64 roods, at 1*s.* 6*d.* per rood -	4	16	0	
	Paring and burning, &c. at 1*l.* 2*s.* 6*d.* per acre	6	3	9	
	Once ploughing, at 1*l.* per acre - -	5	10	0	
	19 chald. of lime and leading, at 1*l.* 2*s.* per chal.	20	18	0	
	Spreading ditto, at 9*d.* per chaldron -	0	14	3	
	Twelve bushels of seed rye, at 5*s.* 9*d.* per bushel	3	9	0	
	Sowing, harrowing, &c. at 3*s.* 6*d.* per acre	0	19	3	
	To 64 roods of fence wall, at 2*s.* 6*d.* per rood	8	0	0	
	Gates and incidental expenses - -	1	4	0	
		L. 106	14	3	
	1807.				1807.
	Corn reaping, carrying, stacking, &c. at 1*l.* 4*s.* per acre - - -	6	12	0	32 bushels of rye per acre. 5a. 2r.=176 bushels, at 6*s.* 3*d.* per bushel=55*l*
	Thrashing 22 qrs. of rye, at 4*s.* 6*d.* per quarter	4	19	0	
		L. 11	11	0	
1808.	1808.				1808.
Three times ploughed and three times harrowed, and sown with rape, which was eaten on the ground with sheep.	Three times ploughing, and three times harrowing, at 12*s.* 6*d.* per acre - -	9	18	0	Rape worth 2*l.* 10*s.* per acre. 5a 2r. at 2*l.* 10*s* per acre=13*l.* 15*s.*
	Rape seed and sowing - - -	0	11	0	
		L. 10	9	0	
1809.	1809.				1809.
Once ploughed and harrowed, and sown with oats and seeds; same quantity of seeds as before.	Once ploughing and harrowing, at 12*s.* per acre	3	6	0	24 bushels of oats per acre. 5a. 2r.=132 bushels, at 3*s.* 9*d.* per bushel=24*l* 15*s.*
	25 bushels of seed oats, at 4*s.* 6*d.* per bushel	5	12	6	
	Corn reaping, carrying, stacking, &c. at 16*s.* per acre - - - -	4	8	0	
	Thrashing 16½ quarters of oats, at 1*s.* 2*d.* per qu.	0	19	3	
		L. 14	5	9	

Now worth 14*s.* per acre.

In this piece the expenses are less than in the proceeding one, but more considerable than in the two former, and the present value equal to No. III.

Other pieces of ground of the above description have been brought into a state of cultivation beneficial to the support of the community, preceding the date of the above, but of which the particulars required by the Board have not been preserved, and are therefore omitted for its inspection.

No. V. contains 2 acres, 3 roods, 35 perches.

How cultivated.	Expenses.	£.	s.	d.	Produce.
1807.	1807.				
Pared and burnt, once ploughed, harrowed, limed, and sown with rye.	Cutting and breaking stones, at 4*l.* 4*s.* per acre	12	9	0	
	Carrying stones off the land - -	18	0	0	
	Draining 12 roods, at 1*s.* per rood -	0	12	0	
	Paring and burning, &c. at 1*l.* 2*s.* 6*d.* per acre	3	6	6	
	Once ploughing, at 1*l.* per acre - -	2	19	0	
	Ten chaldrons of lime and leading, at 1*l.* 2*s.* per chaldron - - -	11	0	0	
	Spreading ditto, at 9*d.* per chaldron -	0	7	6	
	6½ bushels of seed rye, at 6*s.* 6*d.* per bushel -	2	2	3	
	Sowing, harrowing, &c. at 3*s.* 6*d.* per acre -	0	10	3	
	To 55½ roods of fence wall, at 2*s.* 6*d.* per rood	6	18	9	
	Gates and incidental expenses - -	1	0	0	
		£59	5	3	
	1808.				1808.
	Corn reaping, carrying, stacking, &c. at 1*l* 4*s.* per acre - - -	3	11	3	30 bushels of rye per acre. 2a. 3r. 35p.=88 bush. at. 6*s.* 9*d.* per bushel= 29*l.* 14*s.*
	Thrashing 11 qrs. of rye, at 4*s.* 6*d.* per quarter	2	9	6	
		£6	0	9	
1809.	1809.				1809.
Three times ploughed, and three times harrowed and sown with rape, which was eaten on the ground by sheep.	Three times ploughing and three times harrowing, at 12*s.* per acre - -	5	6	9	Rape worth 18*s.* per acre. 2a. 3r 35p. at 18*s.* per acre =2*l.* 13*s.* 5*d.*
	Rape seed and sowing - -	0	6	0	
		L. 5	12	9	

Now worth 12*s.* per acre.

No. VI. contains 5 acres, 1 rood, 17 perches,

How cultivated.	Expenses.				Produce.
1808.	1808.				
Pared and burunt, once ploughed, harrowed, limed, and sown with rye.	Cutting and breaking stones, at 5*l.* 10*s.* per acre	29	9	0	
	Carrying stones off the land - -	32	10	0	
	Draining 164 roods, at 1*s.* 6*d.* per rood -	12	6	0	
	Paring and burning, &c. at 1*l.* 2*s.* 6*d.* per acre	6	0	0	
	Once ploughing, at 1*l.* per acre - -	5	7	0	
	Eleven chaldrons of lime, and leading, at 1*l.* 2*s.* per chaldron - - -	12	2	0	
	Spreading ditto, at 9*d.* per chaldron -	0	8	3	
	Twelve bushels of seed rye, at 7*s* per bushel -	4	4	0	
	Sowing, harrowing, &c. at 3*s.* 6*d.* per acre -	0	18	7	
	To 39½ roods of fence wall, at 2*s.* 6*d.* per rood	4	18	9	
	Gates, and incidental expenses -	1	4	0	
	L.	109	7	7	
	1809.				1809.
	Corn reaping, carrying, stacking, &c. at 16*s.* per acre - - -	4	5	8	12 bushels of rye per acre. 5a. 1r. 17p. =64 bush. at 8*s.* 3*d.* per bushel= 26*l.* 8*s.*
	Threshing 8 qrs. of rye, at 5*s.* per quarter -	2	0	0	
	L.	6	5	8	

Now worth 10*s.* per acre.

Those six closes are situated in the moors, and so steep, the plough could only work down the hill the first time of ploughing.

We do hereby certify that No. 1, 2, 3, 4, 5, and 6, have been cultivated as above, and are now of the value herein stated.

DAVID EDWARDS.
WILLIAM GARBUT.

1810. *An Account of the Cultivation, Expense, and Produce of Waste Land in the Parish of Helmsley. Previous to being broken up, the Surface was covered with Ling, and on some of the best parts Brackens intermixed.*

No I. contains 12 acres.

How cultivated.	Expenses.	L.	s.	d.	Produce.
1806.	1806.				1806.
Pared and burnt; twice ploughed, and twice harrowed and limed.	Paring and burning, at 1*l.* 10*s.* per acre	18	0	0	Turnips worth 3*l.* 10*s.* per acre, 4 acres, at 3*l.* 10*s.* per acre = - L. 14 0
Eight acres sown with rape, and four acres sown with turnips, all eaten on the ground with sheep.	Twice ploughing and twice harrowing, at 12*s.* per acre - - -	14	8	0	Rape worth 1*l.* 5*s.* per acre.—8 acr. at 1*l.* 5*s.* per acre 10 0
	Forty-eight chaldrons of lime and leading, at 15*s.* per chaldron - - - -	36	0	0	Total value L.24 0
	Spreading ditto, at 9*d.* per chaldron -	1	16	0	
	Ten days carting earthy soil on the worst parts, at 9*s.* - - - - -	4	10	0	
	Rape and turnip seed, and sowing -	1	4	0	
	Four acres of turnips hoeing, at 7*s.* per acre	1	8	0	
	To fencing 52½ roods with posts, rails, and quickwood, at 6*s.* 3*d.* per rood - -	16	8	1	
	To fencing 62 roods, part with posts and rails, and part with a hedge, at 4*s.* 6*d.* per rood	13	19	0	
	Gates and incidental expenses - -	2	0	0	
		L. 109	13	1	
1807.	1807.				1807.
Twice ploughed, and twice harrowed and limed.	Twice ploughing and twice harrowing, at 10*s.* per acre - - -	12	0	0	About 24 bushels of oats per acre. 6 acres = 144 bushels, at 3*s.* 9*d.* per bushel = - L. 27 0
Six acres sown with oats, and six acres sown with barley and seeds, (viz.) 9lb. of white clover, 2lb. of trefoil, 1lb. of red clover, 1 bushel of rye-grass, 3 bushels of hay-seeds, and afterwards twice rolled.	Twice rolling - - -	1	6	0	Only 16 bushels of barley upon the 6 acres, at 4*s.* 6*d.* per bushel 3 12
	Thirty-six chaldrons of lime and leading, at 15*s.* per chaldron - - -	27	0	0	L. 30 12
	Spreading ditto, at 9*d.* per chaldron -	1	7	0	
	Fifteen bushels of seed barley, at 5*s.* per bushel	3	15	0	
	Thirty ditto of seed oats, at 4*s.* per bushel -	6	0	0	
	Corn reaping, carrying, stacking, &c. at 12*s.* 6*d.* per acre - - -	7	10	0	
	Thrashing 18 qrs. of oats, at 1*s.* 2*d.* per quarter	1	1	0	
	Ditto 2 quarters of barley, at 4*s.* per acre -	0	8	0	
	Cleaning quickwood - - -	0	7	6	
		L. 60	14	6	

1808 and 1809. Pastured with sheep and small cattle, and now worth 13*s.* per acre.

No. II. contains 8 acres 2 roods.

How cultivated.	Expenses.	L.	s.	d.	Produce.
1807.	1807.				1807.
Pared and burnt, once ploughed and harrowed. Limed, and sown with turnips, which were eaten on the ground with sheep.	Paring and burning, at 1*l.* 10*s.* per acre	12	15	0	Turnips worth 2*l.* 10*s.* per acre. 8 a. 2r. at 2*l.* 10*s.* per acre=21*l.* 5*s.*
	Once ploughing and once harrowing, at 13*s.* per acre	5	10	6	
	Thirty-four chaldrons of lime and leading, at 15*s.* per chaldron	25	10	0	
	Spreading ditto, at 9*d.* per chaldron	1	5	6	
	Turnip seed and sowing	0	17	0	
	Turnips hoeing, at 7*s.* per acre	2	19	6	
	To fencing 125½ roods with posts and 3 rails, at 5*s* 6*d.* per rood	34	10	3	
	To fencing 17 roods with a bank and hedge, at 4*s.* per rood	3	8	0	
	Gates and incidental expenses	1	0	0	
		L. 87	15	9	
1808.	1808.				1808.
About 13 cart load of dung per acre; once ploughed and sown with oats. In autumn once ploughed and harrowed, part sown with rye and part with masslin, the crop tolerable; but this course of husbandry ought not to be practised upon so poor a soil.	Dung carrying	5	10	0	About 44 bushels of oats per acre. 8a. 2r.=374 bushels, at 4*s.* 3*d.* per bushel=79*l.* 9*s.* 6*d.*
	Once ploughing and harrowing, at 10*s.* per acre	4	5	0	
	Thirty-nine bushels of seed oats, at 4*s.* 6*d.* per bshl.	8	15	6	
	Corn reaping, carrying, stacking, &c. at 1*l.* per acre	8	10	0	
	Thrashing 47 quarters of oats, at 1*s.* 2*d.* per quar.	2	14	10	
	Once ploughing and once harrowing, at 10*s.* per acre	4	5	0	
	Nineteen bshls. of seed rye, &c. at 7*s.* 6*d.* per b.	7	2	6	
		L. 41	2	10	
	1809.				1809.
	Corn reaping, carrying, stacking, &c. at 18*s.* per acre	7	13	0	About 6 bushels per acre. 8a. 2r.=136 bushels, at 8*s.* 3*d.* per bushel=56*l.* 2*s.*
	Thrashing 17 quarters, at 4*s.* per quarter	3	8	0	
		L. 11	1	0	

Now worth 13*s.* per acre.

We do hereby certify that No. 1 and 2, in the parish of Helmsley, have been improved, and are now of the value above stated.

JOHN ROBSON,
WILLIAM WRIGHT.

No. III. contains 15 acres.

How cultivated.	Expenses.				Produce.
1807.	1807.				1807.
Pared and burnt in the spring; once ploughed and once harrowed: limed and sown with turnips, which were eaten on the ground with sheep. In the autumn of 1807, 5 acres once ploughed and harrowed, and sown with rye.	Paring and burning, at 1*l.* 10*s.* per acre -	22	10	0	Turnips worth 2*l.* per acre. 15 acres, at 2*l.* per acre, =30*l.*
	Once ploughing and harrowing, at 13*s.* per acre	9	15	0	
	Sixty chal. of lime and leading, at 15*s.* per chal.	45	0	0	
	Spreading ditto, at 9*d.* per chaldron -	2	5	0	
	Turnip seed and sowing - - -	1	10	0	
	Turnips hoeing, at 5*s.* per acre - -	3	15	0	
	Fencing 125½ roods with posts and 3 rails, at 5*s.* 6*d.* per rood - -	34	10	3	
	Five acres, once ploughing and harrowing, at 10*s.* per acre - - -	2	10	0	
	11¼ bushels of seed rye, at 6*s.* 6*d.* per bushel	3	14	9	
	Gates and incidental expenses -	1	10	0	
		L. 127	0	0	
1808.	1808.				1808.
Ten acres once ploughed and harrowed, and sown with oats.	Ten acres once ploughing and harrowing, at 10*s.* per acre - - -	5	0	0	Upon the 5 acres 16 bush. of rye per acre=80 bush. at 6*s.* 9*d.* per b.=£27 0
	48 bushels of seed oats, at 4*s.* 6*d.* per bushel	10	16	0	40 bush. of oats per acre upon the 10 acres=400 b. at 3*s.* 9*d.* per b.= 75 0
	Corn reeping, carrying, stacking, &c. at 19*s.* per acre - - -	14	5	0	
	Thrashing 10 quarters of rye, at 4*s.* 6*d.* per qr.	2	5	0	
	Ditto 50 quarters of oats, at 1*s.* 2*d.* per qr.	2	18	4	
		L. 35	4	4	Total value *L.* 102 0
1809.	1809.				1809.
Three times ploughed and five times harrowed and limed. 3 acres sown with rape, and 12 acres sown with turnips, all eaten on the ground with sheep.	Three times ploughing and five times harrowing, at 12*s.* per acre - - -	27	0	0	Rape worth 2*l.* 10*s.* per acre.—3 acres, at 2*l.* 10*s.* per acre= - *L.* 7 10
	Two days carting earthy soil on the worst parts, at 8*s.* - - - - -	0	16	0	Turnips worth 3*l.* 10*s.* per acre, 12 acres, at 3*l.* 10*s.* per acre= 42 0
	Thirty chal. of lime and leading, at 15*s.* per ch.	22	10	0	
	Spreading ditto, at 9*d.* per chaldron -	1	2	6	
	Turnip and rape seed, and sowing - -	1	4	0	
	Turnips hoeing, at 7*s.* per acre - -	4	4	0	
		L. 56	16	6	Total value *L.* 49 10

Now worth 12*s.* per acre.

I do hereby certify that No. 3, in the parish of Helmsley, has been improved, and is now of the value above stated.

THOMAS OWRAM.

No. XXI.

On the Acacia Tree. By the Rev. J. Willis, *of Sopley, near Ringwood.*

Sir,

It has ever been my wish to convey to the Honourable Board of Agriculture, any information that may be of use to the public, as well as to the individual. I beg leave, therefore, to submit to your consideration, a few facts relative to the Acacia, which, I hope, will induce other gentlemen to cultivate this tree; and which I think I can illustrate by certain examples, to be one of the most valuable among those that we are now raising in our plantations. I am inclined to believe, that the specimen, and its history, which I now transmit to the Honourable Board, will most fully prove to your conviction, that, if quality of timber, or wood of real use, with quantity, in any given time of growth, be taken into consideration, there is no tree, in the generality of soils, will reward the labours of the planter more satisfactorily, than this species of acacia, I am now permitted to describe. In rapidity of growth, this tree, in some soils, will equal the poplar or willow tribe; and at the same time it possesses the durability and closeness of texture of the yew and the box. The specimen is part of a tree I planted in a pure gravel, trenched three feet, with many others of different kinds, in the year 1782; it has been cut down two years, and I have made several book cases of it for my library, and other things for the use of my family. It is certainly well adapted for all cabinet purposes, from the beauty of its feathering and closeness of grain. I have some beautiful grained planks by me now, which would make the styles of drawing-room doors, or any ornamental furniture. The coarser parts of this timber I have applied to farming and other out-door purposes, which I find equal to oak, in its wear and tear. In the same year, and in the same gravelly soil, I planted firs, Lombardy poplars, and weeping willows; one of the poplars now measures eight feet two inches in circumference, and is 70 feet high; and I brought the cuttings of the poplars, in my portmanteau, from Lord Rochfort's plantations at St. Osyth's, in Essex, no bigger than a tobacco pipe. I mention this circum-

stance, to prove to those young men who now are beginning the world, and have wealth and scope of ground, and wisdom and foresight enough to apply both to their own advantage, as well as that of the public, that they should omit no opportunity of planting every inch of ground within their domains, that is not applied to grain; and whatever be the nature or quality of the soil, if they go judiciously to work, some sort of tree or another will assuredly reward their labour.

I really despaired myself, when I first planted this rock of gravel, of any sort of tree vegetating in such a situation; but a few years have amply rewarded my pains, by giving me many hundred feet of timber of various kinds, and at a time when, perhaps, it never before carried such enormous prices. I must not omit saying, that I have been offered by a carpenter 3*s.* 6*d.* per foot, for some of my acacia planks, which are from the saw an inch and a quarter thick. There are but few trees of English growth that will exceed this in price.

It may be necessary to point out the species of acacia I am now recommending, and I shall state, for that purpose, the following extract from Miller's Dictionary. "*Gleditsia polysperma,* three-thorned Acacia. This tree is common in most parts of North America, where it is known by the name of the honey locust; is called by the gardeners here, the three-thorned acacia; it rises with an erect trunk to the height of thirty or forty feet, and is armed with long spines; leaves bipinnate, composed of ten pairs of leaflets of a lucid green; the flowers come out from the side of the young branches, and being of an herbaceous colour, make no great figure: legume near a foot and a half long, and two inches broad; seeds smooth, surrounded by a sweet pulp."

There is a tree of this sort in the Bishop of London's garden at Fulham, which produced pods in the year 1728, that came to their full size, but did not ripen: it appears from Pluknet, that it was cultivated by Bishop Compton in 1700. This is an elegant tree, and grows best when most sheltered; it should have a deep soil; if the ground is strong and shallow, the tree becomes mossy. It is propagated by our gardeners from seeds procured from America, annually sent to England by the title of locust, or honey-locust, to distinguish it from the false acacia, which is frequently called locust-tree in America.

Notwithstanding the authority here quoted, that a deep soil is requisite for its success, I am inclined to believe, that it is a tree of that hardy nature, that it will flourish in a variety of soils and situations, of which I shall point out a few of

the most opposite, which this neighbourhood has afforded me an opportunity of selecting. The specimen sent, was planted by myself in a rock of pure gravel, but thoroughly broken and trenched, as I have before observed, three feet deep, without a particle of mould, and rather an exposed situation. The trees were about thirty feet high before I cut them, and were certainly in a very thriving condition. Nothing would have induced me to have removed them, but they were getting too lavish for their situation, as they destroyed some other plants beneath them.

There are now growing in the gardens of Ibsley, near Ringwood, in a bank of gravel, some trees of this species, in a very healthy growing state.

There are also some of this species growing in a strong loamy soil at North End, near Ringwood: they certainly grow more vigorously than those on gravel, and promise to be very valuable trees. The largest tree growing in this country is on a bed of pure chalk, in the gardens of Whitsbury-house, near Fordingbridge, belonging to Lord Shaftesbury.

In the grounds of the Reverend John Helyar, at Turnham, in Dorsetshire, an acacia was planted as a shrub, in the front of a rustic cell, but its increase was so prodigious and rapid, that it overcame all opposition of pruning: in a few years this tree has overshadowed the grotto, and completely hid it from the parlour windows; but I must observe, that this luxuriant acacia is now growing in a bed of flints intermixed with chalk; and I am told the hole, in which it was planted, filled with water the instant it was dug.

Here it may be useful for the planter, that I should repeat again most distinctly, that at Sopley and Ibsley, the acacia grew on a pure gravel; at North End, in a strong soil; at Whitsbury, on a chalk; at Turnham, in a bed of flints, through which runs a continual stream of water: these instances are strong proofs of what I premised, that the acacia will flourish on the most unpromising soils.

In America, where this beautiful tree is indigenous, it is every where seen in the wilderness, on the plain, in the valley, on the mountain. It is found to the southward on the borders of the gigantic Misisippi; and in the United States, from Georgia to New Hampshire. Lord Valentia, in his travels through Abyssinia and Egypt, lately published, says, that the villages and gardens, as they proceeded, were protected by a fence, formed from large branches of the thorny acacia; and in other places of this entertaining work, we find his Lordship informing us, that the

acacia grew to the height of forty feet in some situations, and nearly covered the face of some countries they travelled through. Thus it appears to agree with most soils in any exposition, and with the extremes of hot and cold climates.

If I am informed correctly, by an American gentleman, it is the only tree the natives select for planting for shade and for ornament: a new settler too hastily, with a remorseless axe, clears every thing before him; but he soon finds in his habitation the scorching rays of a vertical sun, which compels him to create a shade in planting the spreading acacia, which he had incautiously removed, and which a little foresight and prudence would have induced him to have spared. Woods judiciously cleared, and clumped in different positions, must afford an agreeable shade and shelter for their habitations, especially from the tinted foliage, and elegantly pendant flowers of the acacia: the sweetness of its pulp contained in the pod is very attractive of bees, and which circumstance has, in America, given it the name of the honey locust. As timber, it is also in great repute in America in ship-building, where straight wood is required for top timber, timber heads, &c. &c.: but for one particular purpose it is almost invaluable, and that is for trunnels, or wooden pins, which bolt the outside planks to the inside timbers of a ship, which must be considered by us as a very material article in naval architecture. I am informed of a vessel, now in the Greenland trade (the Manchester of Hull), that was built 40 years ago at Philadelphia of live oak and yellow pine plank, driven with locust or acacia trunnels; she has been in constant employ, and was lately overhauled at Mr. Mastner's dock: the trunnels were driven back with great difficulty, and were found to be as perfectly sound as when they were first put in. Millions of trunnels are brought into this country, which are bought up by the ship-builders, who prefer them for their toughness, their never shrinking, and their aptitude to drive better than any other description of wood. This tree in America is found from four to five feet diameter; the roots run large and crooked, and from their excessive toughness, are much sought after for knees for small craft and boats. I have seen lately something of an introduction spoken of earthen-ware sheaves in the blocks of the ships of the navy. Surely this must be too brittle a substance, so very essential to the movements of a ship, in performing those powerful and active operations, in which the blocks are employed. This part of the machinery hitherto has been made of the hardiest woods, and cast metals;

and from the experiments I have made of the acacia, I rather think this wood would make more durable sheaves than those of earthen ware, however compounded, and very little inferior to *lignum vitæ*. The fate of the nations around us has wonderfully revolutionized the things of the world, and among these changes, timber of all kinds, foreign and domestic, has tripled its value; Scotch fir, beech, and even inferior woods are now used in buildings, where they were never applied before: necessity has even introduced the poplar tribe, as a miserable substitute in some instances for red and white deals. I have seen some parlour floors and doors made of Scotch fir, cut when the sap or turpentine was up, that stand tolerably well; if these were constructed of acacia, I have no doubt of their enduring for centuries. The thinnings of the old Duke of Cumberland's plantations at the Virginia Water, I am told, now sell from 2*s.* to 3*s.* per foot, which are chiefly of Scotch fir. If the Duke had known in those days the value of the acacia, and had intermixed them with other trees in his plantations, what an immense difference in point of money, and in paying for the use of the land, on which they grew, would the thinnings of the acacia produce? This soil would carry the acacia well, and would pay a per centage per acre, superior in my opinion to any other wood. My time would fail me on this occasion, were I to enumerate the examples of gentlemen in England and Scotland, who are at this moment receiving immense advantages, even from the very thinnings of their plantations. This consideration, as well as the great demand, with the consequent rise on all sorts of timber, most fully declare the absolute necessity of applying every foot of our wastes, that is not adapted to the product of grain, to the growth of timber; the species and quality of the tree to be suited to the nature and quality of the soil. A judicious cultivator will use his strength and resources accordingly; the best part of his wastes will carry corn; the inferior many sorts of timber, that are most likely to agree with the situation and soil. But many gentlemen have misapplied their money and their exertions, both in planting of a grain and a species of timber, by no means agreeing with the nature of the ground, which they have broken up from a state of nature. The quality in all respects should be the first thing considered, its strength, its weakness; next the elevation or lowness of situation; then the fitting of the grain or tree to its allotted place. Here then is a field calling forth the nicest judgment of the cultivator; and in this discrimination, the future ill or good success of the undertaking wholly depends: the not duly considering the different qualities of waste land, which require as many different

modes of application and management, has been very prejudicial to the individual interest of certain gentlemen, who have inconsiderately and hastily embarked in these speculations; their plantations have failed under an improper management and selection of trees and soil; they have been too disgusted with the unsuccessful experiment to renew their labours; and the whole has been permitted to return again to a state of nature. A friend of mine, some years back, planted some thousands of the acacia or locust tree on a cold black sand, with iron stone at the bottom, on the waste, near Ringwood in Hampshire: they existed for two years, then every plant died. Perhaps there cannot be really a worse soil in the world to plant a tree on than this. I have seen the pinaster and Scotch fir yield to this situation; vegetate for a year or two, and then perish for ever If my friend had maturely examined the nature of the ground, and its substratum, we must deem him more than imprudent, if he had persisted in an undertaking, by which he lost some hundred of pounds. However in some places, in this vast waste, this iron stone, where it has been only two or three inches thick, has been broken; here the roots can expand, and the trees, chiefly Scotch firs, are growing as well as in most other situations.

Planting of timber judiciously, that is, suiting the tree to the soil, appears to be next in consideration to the planting and fitting of that species of grain to the quality of the land, that promises to afford most food for the people. In the present state of things, every possible exertion should be made to raise both, and both are now of such vital and essential importance to the welfare of the state, that the concern really becomes national; as such, if men were not governed by prejudice more than by reason, one half of the military, not on duty, should be instantly employed in cultivating the wastes of the kingdom. Think only on the vast advantages of the profit on the labour of ten or twenty thousand men for one day; multiply it by 365, deducting the Sundays; then imagine what mighty public works might be accomplished for the comfort and happiness of this nation. I am convinced, that the time is not far distant, when we shall see these things as we ought, for the general good of all. Indeed the ruler of France has already given us a lesson on this subject. I read this on a report of the state of Antwerp; " there are about 800 soldiers at work at the new bason, which will be ready in three years; there are 600 men at work in the dock-yard, ship building, &c. &c.; these are ship carpenters and soldiers likewise, so that the whole number of men, fighting men, that is at

Antwerp, does not exceed 2400 men. Their resources for ship building from the Black Forest, through the Rhine, are inexhaustible; the mechanics employed in building these nine ships of the line, are all young men, and chosen from the conscriptive levies; they are formed into military, as well as into labouring order: there are at least a company to each ship building, under the superintendance of a captain. Every Sunday they are exercised to military discipline. All their work is carried on with amazing rapidity." What Englishman can read this without being animated; without urging his fellow countrymen to similar deeds? Look at our military, unemployed, when public roads, immeasurable wastes fit for corn and timber, bridges, canals, harbours, the work of all our dock-yards, might be wonderfully improved and accelerated by the immense increase and addition of that labour which we are daily throwing away, and which our enemy is taking a most tremendous advantage of!

I hope, Sir John, you will pardon the digression used in this address to you. I have certainly been led away from the original subject of the acacia, to others which must at this time very forcibly impress the mind of every thinking Englishman, who wishes to see every resource and advantage of this kingdom fairly and properly applied, civil, military, agricultural; all conspiring to the same views, and uniting in the same great object, of most anxiously maintaining the interest, the credit, and the spirit of our nation.

I am, Sir, your most obedient servant,

JAMES WILLIS.

Sopley, March 1st, 1810.

The Right Hon. Sir John Sinclair, Bart.
President of the Board of Agriculture.

No. XXII.

Essay on Gates for the common Purposes of Farms; their Construction; Causes of Decay, and Manner of improving. By Mr. Robert Salmon, *of Woburn, Bedfordshire.*

FROM the circumstance of gates being so very common, and generally used, it seems difficult to suppose that any room remains for discussion or serious inquiry on the subject; but when it is considered that (differently from many articles in husbandry), in all districts there can be but very little difference in their requisites, and that in every district their formation and construction is different, it leaves room to doubt whether some general rule may not be communicated to the public with advantage, and with this view the following lines are submitted.

In order properly to investigate the subject, it will be useful to consider, first, the purposes gates are generally meant to answer; secondly, (according to their common construction), what their general defects, duration, and causes of decay or destruction; thirdly, what the purposes of the different parts of the gate, and impropriety thereof, as frequently met with; fourthly, what the requisites and properties to be combined to form a good gate, and lastly; a description of one wherein these properties are obtained, and comparison with other sorts commonly in use.

First, the purpose of gates (such as are here intended to be treated upon), is considered for occasionally letting horses and carriages pass through, and at other times to keep cattle from trespassing or straying by the same way; they are also purposed to be opened and shut with the least possible management of those who occasionally conduct either horses or carriages passing; and they are generally intended to shut themselves if left open.

In all countries there are commonly met with two sorts of gates, the one for carriages and cattle, and the other for cattle only (called bridle gates); yet it is considered that the requisites in the one and the other are so similar, that they are not here considered distinctly.

Secondly. As gates are now constructed, it is well known, that they together

Fig. 1

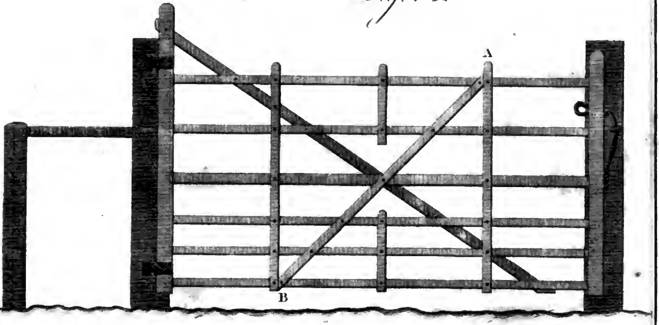
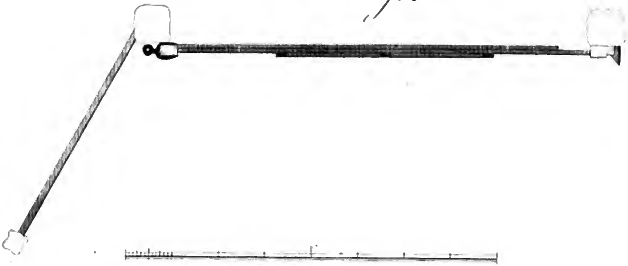


Fig. 2



Neele sc. Strand

Fig. 3

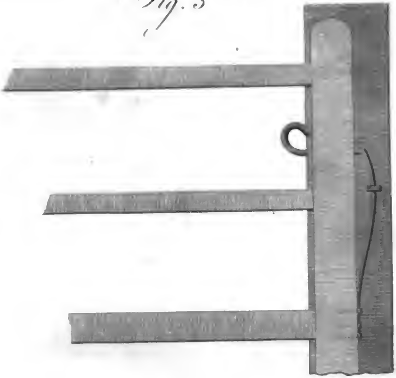
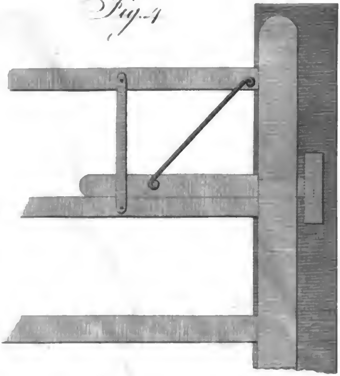


Fig. 4



with the damage sometimes arising from their failure, form a considerable expense in the farming outgoings, and are frequently in want of repair, and yet paradoxical as it may appear, it may be observed that they seldom wear out; this observation occurs in consequence of their more frequently being broken by violence, either in their sound state or state of decay. Previously to stating the accidents that generally lead to the destruction of gates, I shall first premise that their greatest defect is being too low, badly combined and badly hung, and frequently they have these defects with profusion of expense, and too great a quantity of wood in them; this latter described fault shall be first explained. In many districts it is no uncommon thing to see very low four and five barred gates, with a very strong top rail, and wide bottom rail; now, if such a gate was never to be opened or shut, it would be far from being a good barrier, and in the action of opening and shutting, it is likely to be broken much sooner than a slighter gate, for the weight of it in falling to is more likely to break it to pieces; it being a well known fact, that a heavy piece of wood will break to pieces in falling, where a lighter piece may be thrown without danger.

All gates are very liable to be broken in falling to, in consequence of stones or the earth obstructing the bottom part; in which case, where there is a heavy top rail, as that will incline towards the posts with a greater velocity than any other part, it must, in case of such obstruction at bottom, very much strain the tenons and joints of the gate throughout. It is therefore considered that the falling to of low heavy strong gates, is one of their causes of destruction; cattle straining against them and breaking the upper part, is another way by which they are frequently broken, and in considering this way of breaking, it may be a question, whether a very strong top rail is more secure than one that has some elasticity; for many experiments may be adduced, where a very strong non-elastic substance would be broken by a force coming violently and suddenly against it; where one more elastic and slight would have yielded, and gradually have overcome such force. Cart wheels catching the head, heel, brace, or spears, is also another very common case. The top hook drawing out generally, occasioned by the gate being too low and heavy, very commonly occasions complete demolition; latches improperly fixed are frequently the occasion of damage, the gate falling to, and instead of the latch falling into the catch, the gate head or latch falls against the same, and is thereby split to pieces; these, or some of them, will commonly either in a sound or

decayed state, be found to forerun and accompany most gates in their demolition, and but for such causes, it is estimated that they would generally endure twice as long, and be maintained at one third the expense they now are; which consideration furnishes ground to endeavour to render gates less liable to some of these accidents.

Thirdly. Before entering into the merits of any particular sort, form, or make of gates, it may be useful to consider what are the common constituent parts and supports thereto, and their uses. Every gate complete consists of two posts; one of which is meant to hold the hinges whereto the gate is hung, and the other for the purpose of the gate shutting against and holding it when shut: the next parts may be considered as the head and heel of the gate, which are intended to unite and keep at due distance a sufficient number of bars; the heel of the gate to receive a part of the hinge, and connect it with the hanging post, and the head to fasten it to the falling post. A certain number of bars form the next part, which being placed at due distance, make the requisite barrier or stoppage when closed; these described parts, if in themselves they could be conveniently made strong enough, would form the only requisites; but with these parts, namely, the head, heel, and bars alone, it is manifest a good gate cannot possibly be made, wherefore other combinations become requisite; and although these additions are very readily made in different ways, yet as a gate cannot be made without them, it is plain that on them there is very great dependance, and on their proper construction and introduction depends more of the perfection of all gates than has hitherto been considered; these additions are commonly called the braces and uprights, or spears.

The brace is well, and generally, understood to keep the gate from racking or falling at the head, and the uprights introduced to gain some strength, and combine the parts together, and when properly introduced, they do add to the strength and duration of the gate in a very eminent degree: but so very oppositely are these introductions made, that it cannot be doubted but they are frequently applied in a way not the most advantageous. In some gates we see the brace rising upwards from the bottom of the heel to the top rail, in others it is seen descending from the top of the heel towards the bottom rail; and although the advantage of one way more than the other may be demonstrated, if inquiry was made, no one would assign any cause but custom for either way; and whoever has had opportunity of

conversing with persons accustomed to such works, will find that their conceptions on the utility of braces and spears to gates, is to give strength vertically only; whereas, if properly shaped and introduced, they add very much to their strength on the face, and increase very much their power of horizontal resistance.

Most persons are aware that a piece of wood or metal will support an immense weight applied to it by tension; but when placed perpendicularly, it will not support its own weight, and it is equally plain, that any piece of wood or metal, to which a weight hangs pendant, is stronger on the face of it as it is loaded or lightened, and on this principle the due formation of gates should be considered, though apparently not at all adverted to.

Fourthly. The particular requisites for gates are considered to be as follows.

1. Every gate should be so constructed and hung, that persons passing with cattle or carriages can in the most convenient way open and shut it.

2. When shut and fastened, it should be so secure that cattle cannot open it, or be tempted to break it.

3. In case of inattention of persons passing, it should shut itself, and in this action it should be so constructed as to be least liable to derangement.

4. It should be so constructed, that in case of breaking and derangement, it may be easily restored and repaired; and lastly, it should be made of the most common and economic materials. The ways that present themselves for obtaining these requisites are, 1. To make it convenient and safe to pass, nothing will contribute more than making it high; being so made, it will most readily turn horses in a proper position for the rider to open it; thus made, it will appear more formidable for horses or cattle to stop before approaching too near it; and being high, the latch will of course be high and most convenient for a rider to open, or so to hold it for carriage or cattle to pass.

2d. To make it most secure when shut, must in some degree depend upon the fastening; but the necessity for strength in this, will be diminished as the gate is made high: various sorts of fastenings have been used, some very good and some very bad, on which little here need be said; but a consideration of first importance here arises, namely, that cattle should not have the inclination or power to pass; to provide for this against large cattle, it must be allowed, that heighth is of the utmost consequence, for it may be adduced, that if a gate be so high that no horse or ox can get its head over it, a very slight one will suffice, and no animal

will attempt to force it; whereas was it so low that an horse or ox could get the head or chest upon it, then, although strongly made, it would be readily broken at the first attempt or inclination of the animal; which inclination they would constantly have. Proofs of this may be daily seen in parks, &c. where very slight high fences do effectually check the strongest of cattle, as long as the fence holds together.

3. To make it shut itself must of course depend on the proper shape of iron-work; and that it may not be deranged in shutting, much depends on the substance and manner of combining the parts of the gate, as well as proper iron-work. A rail and post should be placed so as to prevent the gate opening more than 120 degrees. If the top rail of a gate be very heavy, and the other bars wide and heavy, it will be very subject to derangement in falling to, and the more so, when the wind is so situate as to act with the gravity of the gate itself.

4. To make it easy to repair, will depend upon the simplicity of its make and framing; and gates nailed together are more easily mended than those wholly framed. And if the principal part of the gate be of good timber, any inferior sort may be used in the other parts. In combining the requisites, the following remarks may be useful. Elasticity is considered a necessary property in the top rail of all gates, in order to profit of the aid to be derived from the other rails, braces, and spears.

In the rails of gates it is better to have an additional number rather than to increase the width of them.

In braces and spears, thickness is of importance, as thereby their combination is more effectual, and they add more to the strength of the rails.

In both rails, and braces, and spears, the nearer the dimensions of the wood approaches to a cube, the more durable will the substance be, and in a well framed gate the substance is wanted on the face as much as vertically; also the substance this way, holds the wind less than in the other way.

All gates should be fastened on their hooks, as many are broken by being thrown off.

The gate should be so hung that the post should guard the gate at the time carriages pass, and the gate itself should be constructed, that if a wheel catch it in passing, it may recede rather than be torn to pieces.

In many districts much mischief arises from persons stealing the iron-work,

on this account it should be as light as possible, so as to offer the least temptation.

Having thus pointed out the requisites, I shall next endeavour to combine them, see fig. 1. In explaining this gate and appendages, the gate itself will be first considered generally with its particular way of hanging and combining with its posts, and then the particular framing and combination and parts of the gate itself, will be explained and compared with others.

The gate itself is of the usual width, and the top rail not less than five feet from the ground, which height will effectually prevent any sort of cattle from attempting to force it, or should such attempt be made, no cattle can get their chests over the top rail, by which means most gates in common use are broken or strained; and there is little doubt but the top rail of a gate being only 2 inches by $1\frac{1}{2}$ inch, and at this height would endure and be much more secure than another of three times that substance when placed at only two-thirds the height.

Being of this height affords opportunity of great vertical strength, from a slight brace only; so that such gate, with such slight brace, will scarcely ever rack or drop at the head, unless the post itself gives way. It also affords opportunity of placing the hinges so far apart, that they have perfect command of the gate, and that with much less stress on the hooks and hinges, than when the gate is lower and they are nearer together. This is of much consequence, as by failure of the iron-work gates are frequently demolished.

This and all gates will be much best hung according to the plan, fig. 2. the hanging post being so set that the iron hooks come to the middle of the face of the post; being so situate, they are more firmly fixed than when driven in at the angle of the post, as is commonly done: being so fixed, and the post being high, any rough taper timber may be used, leaving it the full size at bottom; when so hung and the gate open, no carriage can catch the heel of the gate in passing, the same laying behind and secured by the post: this is a matter worthy of attention, as they are frequently destroyed or the hooks pulled out by carts catching them in passing. Behind every gate it would well answer to have a post and rail, as per plan, placed at an angle of 120 degrees from the face of the posts; this would prevent the gate from going too far back, and consequently ensure its shutting. This post or rail being also furnished with a hook occasionally to hold back the gate, would add to its security; for want of this, gates are by drivers of teams, frequently

thrown off their hinges and destroyed; they also frequently hold the gate till their team is partly through, and then let it fall probably against the wheels, or they are perhaps set open by a stone at the bottom and so left, and when in that state they are subject to be strained or broken, besides the mischief sometimes occasioned by letting out cattle, &c. If such hook to hold back the gate be placed, it is presumed most men would be at the trouble of discharging it when they had passed.

The shutting post is so placed that it receives the whole of the gate head: this affords opportunity of placing the catch firmly, out of the way, and in the middle of the post. It also prevents the possibility of the gate ever falling between the posts, by which many gates are strained and demolished.

The iron-work of this gate is very light and of little expense, the hooks and hinges being placed as far from each other as the gate and post will admit, for reasons before stated. The latch shewn in fig. 3 is as simple, convenient, and active as it is possible to make one; and it is manifest, that if the gate should drop at the head, from the yielding of the post or other ways, the latch will still perform its office, and it will be scarcely possible for the catch to injure the gate; whereas it will be found that in all gates where the latch rises and falls, they are very seldom long together in order, as the least sinking or rising of the gate head deranges them. This latch being placed high, is convenient to horse and foot, and is as secure from cattle as can be wished.

Next to this latch, one made of wood, as per fig. 4, is recommended. The catch being a piece of wood driven into two holes bored in the face of the post.

The construction of the gate itself will be seen by the elevation, and consists as follows: the heel and head are of sound sawed oak morticed for the bars, and the heel dove-tailed to receive the top of the brace.

The bars are six in number, the fourth in number (being the middle one in height) being the largest.

On one side of these bars the brace passes, and is properly nailed at every intersection with the bars. On the other side is another shorter brace, and two whole-length strengthening spears, these also being nailed at the intersection with the bars. Having generally explained the combination, previously to explaining the properties of the various parts, the difference of the two sides should be understood, and the manner of placing them in the hanging, with respect to the posts, which is of no small importance.—The manner of carters passing gates with a team, and

letting the gate fall against the wheel of their carts or waggons, is so common, that it can scarcely have escaped the observation of every person residing in the country; and it is presumed that more gates are broken this way than by all others, and it thus occurs. The team is generally passing through in the way that the gate opens, and the driver perhaps holds the gate till his shaft horse has passed him, he then immediately lets go the gate, and runs to his fore horses, the gate falls to, and the wheel catches hold of the spear or gate head, and breaks off the same.

To provide against this as much as can be, that side of the gate which has the long brace on it, must be hung towards the posts; consequently the spears will be on the other side, and so situate, will be secure, leaving the head of the gate only subject to be caught by the wheels, and this may be in a great measure secured, by small pieces nailed to the rails, so as to bring them out to the thickness of the gate-head.

The particulars and propriety of the combination of this gate, may be thus illustrated.

The middle rail is largest, for the following reasons.

1st. The stoutest timber being so placed, renders the whole of the gate more in equilibrium with itself; and being there placed, any violent swing or check will least affect or strain the tenons, nails, and other combinations.

2ndly. It has been before observed, that much of the strength, even on the face of every gate depends on a proper combination of the whole; and the middle rail of every gate will be the fulcrum on which all the braces and spears do act.

3rdly. The middle part of the gate being thickest, the braces and spears on each side will be thrown a little arching inwards, the one towards the other, so that the nails will make the whole bind the more firmly together.

The heel of the gate is a straight piece of wood; 1st, because it is most readily and cheaply obtained; 2ndly, it admits the top hook being placed higher, than when the heel crooks just above the rail. The main brace is dove-tailed into the heel, and is made to run from the heel downwards, towards the foot.

1st. Because the dove-tail is the strongest and simplest way.

2ndly. By running downwards from the heel the brace acts by tension, in which way a small substance is equal to a very great load, and the more the load, the stronger and firmer the gate is made on the face thereof; whereas, was the brace reversed so as to act as a prop, it would warp and twist, and become tremulous,

so as to be of no use; and the more it was loaded the weaker it would be. Again, braces introduced in this way are not likely to fail so soon, as when they act as props; because the lower part of the heel of every gate being near the ground, is subject to decay sooner than the upper part, and when the foot of the heel does decay, the brace which runs upwards therefrom immediately loses its abutment, and of course the whole gate falls out of shape; whereas the pendant brace hanging by the dove-tail will endure, and will not be so liable to such decay.

The short brace placed as is shown, is considered of the first consequence in the combination; and this, together with the spears properly placed, increase the strength in a very eminent degree, not only vertically, but also on the face: to explain which, let it be supposed that the gate is shut, and fastened to the shutting post, and some given force applied against the face of the top rail; this force, it will readily be supposed, must be wholly resisted by the strength of the top rail if there was no brace or spear, and if the force was very considerable, it would either very much bend or break the top rail; but when the brace and spear are introduced, the strength of the top rail is increased in a manifold degree, for then the top rail cannot recede without the receding of the next rail also, and the advancing of the lower rails, for the spear must aid the top rail, and act as a lever on the middle rail, forming a fulcrum for it; again also the short brace will assist in like manner, transferring the force applied at the top at A, to the bottom at the other end B, the main-brace and middle rail forming a fulcrum for the short brace to act on.

The gate is principally combined by nails, for various reasons; first, nailing together is the readiest way, and best understood by common workmen; secondly, if well nailed, that fastening acts in every direction; each individual rail has its separate support on the brace vertically, as they have also on the other brace and spears: thirdly, this mode of combination admits of repair more readily than any other.

The scantlings of this gate are small, and the bars not so wide as in common.

1st. Because the greater the scantling, the more the expense.

2dly. Because gates properly braced, do not want wide bars; strength is wanted on the face of the gate as much as vertically; and the nearer the bars and braces are to a cube, the longer will it resist the action of the weather.

3dly. Where one part of the gate is to receive assistance on the face thereof,

by the combination of other parts, it is obvious, that elasticity is requisite: for example, if the top rail was so strong that it could not be bent without breaking, then no advantage could be had from the braces and spears, for, before they could be brought to act, the top rail would be broken.

Particular Dimensions and Value of a Gate made according to Fig. 1 and 2, at Woburn, in Bedfordshire.

	Ft.	In.	In.	In.	£ s. d.	£ s. d.
Posts.						
2 Rough chopped oak posts out of arms or tops of trees, each 9 feet long, aud 8 inches by 8 inches -					- -	1 4 0
Gate.						
1 sawed oak heel,	6	3 long,	4	by 3½		
1 Ditto head,	5	3 long,	3	by 3 -		
1 Ditto brace,	10	3 long,	3	by 1½ - -		
1 Sawed poplar or other common wood, short brace	6	7 long,	3	by 1½ - -		
2 Ditto spears,	5	3 long,	2	by 1¼ - -		
2 Ditto short ditto,	2	3 long,	2	by 1¼ - -		
1 Ditto middle bar,	9	6 long,	3	by 1¼ - -		
5 Ditto other bars,	9	6 long,	2	by 1¼ - -	0 12 9	
31 Nails and labour to rip out stuff and make gate -					0 5 3	0 18 0
Ironwork, 8lb. at 9*d.* - - -					- -	6 0
Setting down gate and posts - -					- -	5 0
Rough stop post, and rail behind gate - -					- -	2 0
						£2 15 0

No. XXIII.

Agricultural Hints, collected by Sir John Sinclair, *in the Course of an Excursion to Holkham, during the Easter Holidays of* 1810; *with some Observations on the Hundred of Freebridge, (Marsh Land,) in the County of Norfolk.*

I. *On the Improvement, and increased Produce of Norfolk, within the last forty Years.*

About 40 years ago, the whole country from Wells to Lynn, produced, in general, nothing better than rye. When wheat was attempted, the crops were trifling, being destroyed by the red poppy and other weeds. On the farm of Mr. Blomefield, (Warham), the produce in wheat, some years ago, was little more than from four to six bushels per acre. The late tenant increased it to about 18, and the same land now produces 26 bushels of wheat and upwards.

No farmer in Norfolk had, or has at this time, more than about half a sheep per acre of the *Norfolk* breed: many have now two sheep per acre of the *Southdown* breed, and the produce in wool and mutton is doubly valuable. *What a difference, between two acres to one sheep, and two sheep to one acre!*

II. *On cultivating wheat on Clover Layers, and on the Means of preventing the effects of Frost, and the Ravages of the Wyre-worm.*

In many parts of the kingdom wheat cultivated on clover layers, is very apt to fail, which some attribute to the effects of frost, and others to the grub, or the wyre-worm. In Norfolk they in general prevent any loss by attention to the following particulars. 1. Hard stocking the year before ploughing, 2. Early ploughing. 3. Heavy rolling. 4. Sowing on a stale furrow. 5. Early sowing. 6. Drilling. And 7. Harrowing, rolling, and weeding afterwards.

The following Plan for cultivating Wheat on Clover Layers, in general succeeds in Norfolk.

1. Stock the clover layer very hard with sheep and young cattle, so as not to leave on it, when it is ploughed up, the least vestige of herbage, or a single blade

of grass; for if any herbage remains it makes the ground puffy, and furnishes food for grubs and other vermin. 2. Plough up the layer about the second week of September, from four to five inches deep, as the soil will admit of it. The earlier this operation can be performed, the better. 3. As soon as the land is ploughed, compress it with a heavy roller, and in about ten days, or as soon after as any rain has fallen, harrow and cross-harrow it, so as to secure a complete pulverization. 4. By thus ploughing early, a stale furrow may be secured, which is essensial for procuring an abundant crop, where the seed is either drilled, or sown broad-cast. 5. The land must be sown as early as possible, always between the 1st and 20th of October, and not later. 6. On clover layers, drilling nine inches distance is to be preferred to sowing broad-cast, or even dibbling, which latter mode is not necessary with a stale furrow, though it may be advisable with a fresh one. Where the ground is much exposed, three bushels of seed per acre ought to be given;* but in sheltered spots, from eight to ten pecks, four pecks to the bushel, is sufficient—no muck or oil-cake wanted. 7. The seed should be barrowed in with a light barrow. 8. When the wheat is up, a heavy roller should be used in the months of October or November; for though some contend, that the wind has more power to injure the blade, when the land is smooth, yet it is certain that rolling has the effect of preserving the root from injury and destroying the grub. The heavy roller should also be used, in dry weather, in the end of February, or beginning of March; and the drill harrow in March. 9. The crop should be hand-hoed in March (the expense from 2*s.* to 2*s.* 6*d.* per acre;) and if it is necessary, it should be hand-hoed a second time early in April.† Some indeed also use the drill harrow after the first hoeing; but this is not always requisite.

* Mr. Blomefield (Warham) often sows four bushels per acre, being convinced that a thick plant is essential, and it can easily be thinned, if too thick, by cross-harrowing. He is of opinion that thick sowing is a great preventative against the mildew.

† Hoeing is a necessary part of the drill system, but has no effect on the worm, though it benefits the crop. The injury done by the worm is either in the winter, or early in the spring, before the hoeing begins. The hand hoe, for strong land in particular, should be very heavy at the ring, and should be made in the form of a long wedge about eight inches in length from the ring, where the handle is introduced, and five inches in width. The older the layer, the more abundant is the wyre-worm, and the more attention should be paid to the frequent use of the roller.

Had this process been adopted all over the kingdom, in the course of last autumn, more especially in the western counties, thousands of acres, which have been either unfortunately ploughed up, owing to the destruction of the plants of wheat, or where the crop, though left standing, is likely to be deficient, would have this year produced an abundant harvest; and it is in the power of those farmers, who will adopt this plan, rarely again to suffer, from the same circumstances, at least to the same extent.

In regard to frost, it only throws out the plant when the land is puffy, which is easily prevented by pressing and compressing. The wheat also should be sown before the 20th of October, and at a proper depth, not exceeding two inches; in which case no danger is to be apprehended from the frost. This is strongly in favour of drilling on a stale furrow, for the depth can then be regulated with great exactness. When the seed is sown deeper than two inches, the plant is weakened by its efforts to rise from the superfluous depth, and the frost has thus a more powerful effect upon it; often indeed the first effort fails, but the wheat makes a second effort, which, if the season is favourable, answers. Farmers should be extremely cautious, therefore, not to plough up too hastily. The first shoot may be destroyed by the frost; the plant, however, is not killed, but will make a second appearance in the course of the spring. It then rises again out of the ground from the coronal roots which have been formed, and it receives fresh vigour, and produces a good crop, which, however, will not be ripe so soon by a fortnight or three weeks, as a crop that has not been checked by the frost. Insects, also, may destroy the seminal fibres; but if the coronal roots are formed, the insects may check the growth, but they will not destroy the plant.

The wyre-worm is the great enemy to wheat on clover layers. It has greatly increased on light soils, since fewer cattle have been fed with the sheep, both on layers and on the turnips. On turnips, the proportion used to be, 15 head of young light cattle to about 200 sheep, or sometimes five head of cattle to 100 sheep. This gave a firmer texture to the soil, the treading tended to destroy the vermin and their eggs, and the land broke up much better. On layers, particularly if they are above one year old, a certain proportion of cattle should always be kept, to devour the coarser herbage. Some farmers keep among their sheep, at the rate of one small lean stot or bullock, to every ten acres of clover, for the purpose of eating the knots and coarser herbage, which the sheep will not touch.

If the season is moist, the proportion of cattle ought to be increased. The herbage of a field is thus kept so close as to resemble a bowling-green.

Rooks ought to be preserved by farmers, being the great enemy of the wyre-worm. It has been ascertained, that the rook prefers them to every other species of food. It is said that the wyre-worm is not so prevalent on the Continent, as in England. There they sow no wheat upon layers, but after fallow, hemp, or flax; the land thus gets abundance of tillage, and the birds destroy the worms. They sow, after layers, pease or beans, and then turnips, according to the soil.

It is certain that tillage is the greatest enemy to the wyre-worm, and, perhaps, it would in many cases be advisable, to sow some other crop, as pease or beans, previous to the wheat; at the same time, if the layer is treated in the manner above recommended, there is little risk of failure.

III. *On Drilling.*

The intelligent farmers near Holkham, as well as their respectable landlord, Mr. Coke, all prefer drilling. Mr. Reeve commenced drilling 15 years ago, and now drills all his crops of grain, wheat, barley, and oats. He sows three bushels of wheat and barley, wishing to have a full plant. The barley, having grass seeds sown with it, cannot be hoed; but the oats are hoed, first with a drill harrow, (an implement that ought to be universally used where drilling is practised); it should be then once horse-hoed, and afterwards weeded by the hand. Mr. Blomefield, (Warham), began drilling about 12 years ago, and greatly prefers the drill, to the broad-cast system, for all grain crops. He tried the experiment on a large scale, for three successive years with barley, oats, and pease; and he found the drill so superior, that he has never sown any broad-cast since. The produce was greater, and the quality better. There was no saving in point of quantity of seed worth mentioning. Drilling barley is peculiarly expedient, as the seed may be put near the surface, (which is highly desirable, making the crop come up more regular), and the clover sown on land when drilled has more air than when the crops are sown broad-cast.

VI. *On cultivating Wheat on small Ridges, instead of Drilling.*

Mr. Money Hill is of opinion, that when land that has been fallowed, cannot be drilled before the 20th of October, it is better to plough in the wheat on four

feet ridges. On wet soils this system is advisable, because it keeps the seed dry; and in thin soils, because it increases the staple; for by this system, the soil of five feet is put on four; and from many years experience, Mr. Hill is convinced that the produce is as great, as if the whole land had been under crop.*

V. *Scarifying.*

An intelligent farmer in Norfolk observed, that it is a bad practice to depend too much on scarifying; and he considers good ploughing necessary for the proper nourishment even of barley crops. Many farmers however, in Suffolk, and in other districts, in general, raise abundant crops of spring corn, and of barley in particular, without spring ploughing.

VI. *Turnips.*

Mr. Blomefield cultivates about 170 acres of turnips every year. He sows three sorts. 1. The decanter turnip, which goes off in January, not bearing frost. 2. The common Norfolk turnip, which bears more top, and stands the frost well. And 3. The Swedish, of which he commonly has about 20 acres, and this year about 32 acres.

He has never ploughed up an acre of turnips, though he has sown annually about 170 acres for about 17 years; but—1. His land is in good tilth and heart, by oil cake and muck. 2. He sows from four to eight pints of seed per acre, according to the soil, four pints on light lands, and eight pints on strong unkind lands. And 3. The seed should be sown when the land is fresh ploughed and moist, so that the plants come up all together; otherwise the fly takes them as they come up.

VII. *Feeding Horses.*

The Norfolk farmers in general give about $1\frac{1}{2}$ bushel of oats to their horses per week; but some give more. Mr. Blomefield has tried barley, and finds, that, when steeped or grown, it is excellent food for horses. In that state it does not heat them; and indeed he considers it to be the finest food there is for cart-horses, or working horses in general, particularly in the spring of the year, when the barley

* The furrows should be moulded early in June by a double-breasted plough, which not only takes up all the weeds then growing, but also the few straggling stems of wheat, which never come to maturity, but serve only materially to injure the sample.

can be sprung. The quantity he gives is the same as of oats, but a comb of dry barley when steeped, will make five bushels, instead of four. Oats are worth at present 10*s*. 6*d*. per comb, and barley about 18*s*.; but usually the difference is only about three or four shillings per comb, in which the additional bushel per comb would equalize the expense. Black barley can often be had at an inferior price. When oats are dear, and barley, or what is called bear or big, is cheap, our Cavalry should be fed with that species of grain, instead of oats.

When horses are first soiled, dry barley may be given them, but in other cases it should always be steeped.

The expense of a horse is about 30*l*. per annum, when they are soiled.

Instead of tares, Mr. Blomefield soils four or five acres of Tartarian oats, commencing about a fortnight after Midsummer; but he begins soiling with clover and rye-grass.

Boiled barley is reckoned the best food for fattening horses quickly.

VIII. *Fences.*

The fences in Norfolk are excellent, and made at a small expense; very different indeed from the cost of the double post and rail.

When new fences are made, the land is, by many good farmers, first fallowed for a year, so as to destroy all weeds, and the soil in which the thorns are to be put, is mixed with chalk or marl, and sometimes with dung: the land is thus prepared for nourishing the young plants. The size of the ditch varies according to the nature of the soil, and other circumstances; but some prefer them five feet wide, from three to four feet deep, and the bank about 20 inches high from the level below the layer, and the same height above it. The expense of ditching and banking varies from 18*d*. to 2*s*. and thence to 3*s*. 6*d*. per rod of seven yards. It is an excellent plan to have gorse or whins, as well as thorns, in your fence. On the ditch side, young gorse, of about one year old, ought to be transplanted, and put under the thorns, about the 11th of April, when the weather is showery, and the risk of severe frosts is over. On the other side, dibble in gorse seed, at one inch deep, six inches separate, and about six seeds in a hole. Where sheep or other stock have access, hurdles are necessary to protect the young thorns and the gorse, but in about three or four years the gorse itself will be a sufficient fence. It is by far the best plan, to make the fence when the field is in wheat, for it will

be free from stock during that crop, and indeed during the next crop being turnips, (unless when the sheep are folded) and also during the third crop, barley. The whin or gorse will then protect the thorns, and no dead fence will be necessary, which otherwise would be required, or at least old hurdles: the gorse should be cut every fourth year, when the layer is broken up. The gorse is of use as firing, but in case of scarcity of feed, it may be given to stock, bruised by mills, or by the flail.

The Rev. Dixon Hoste has favoured me with the following account of the Norfolk fences. " The general fence," he observes, " made throughout this county, " is a ditch and bank, with thorns or brush-wood made into short lengths on the " top of the bank, which bank is made from the earth that is thrown out of the " ditch. In making a new fence, after taking out the first spit of earth, which is " laid as the foundation of the bank, we plant our white thorn layer at four inches " distance, and from the remaining earth in the ditch complete the bank, but great " care should be taken, not to have the bank too steep or upright. The ditch is " five feet wide at top, four feet deep, sloping from the top to the width of one " foot at the bottom; the present price about 2*s.* 6*d.* per rod at seven yards, but " the price may vary to 3*d.* per rod more in case of very bad stiff clay, or stony " soil. It is proper to add, that we allow five feet for the base of the bank, as " well as five feet for the width of the ditch, making together ten feet on level " ground."

On light sandy land, the face of the ditch should be to the north, to prevent the sun having so much power on the soil as to cause it to pulverize and run down upon the young shoots, which loads it and retards its growth.—On the contrary, on stiff clay soils, the face of the ditch should be to the south, to admit the genial warmth of the sun to the young shoots; which on this soil is necessary.—On mixed soils the aspect of the ditch is immaterial.

The Cockspur thorn from America, would, there is every reason to believe, make a much better fence than the white thorn; and by an experiment tried by Mr. Coke, at Mr. Overman's farm, it seems to be more rapid in its growth. The seed should be imported from America, where it can be had cheap. Application has been made to Mr. Pinckney, the American Minister, and to Dr. Logan, a respectable proprietor in that country, to procure a quantity for the Board of Agriculture.

IX. *Queries to, and Answers by, Mr. Blomefield.*

Q. 1st. What do you consider to be a proper stock of horses and labouring men for a farm of 300 acres, managed according to the Norfolk system?

A. Nine horses and six men—also a boy and a few women for hoeing.

Q. 2. What is the best proportion of pasture for such a farm?

A. One fifth.

Q. 3. When 20 head of cattle are fed on turnips, what quantity of manure will they make in the season, and for how many acres; the dung to be laid on for the turnip crop?

A. Three hundred loads of muck laid on to 30 acres, being ten load per acre.

Q. 4. When six horses are soiled in the summer, and kept in the stable all winter, what quantity of manure will they make in a year, and for how many acres of turnips?

A. Six horses, 120 loads of muck laid on 15 acres, being 8 loads per acre.*

Q. 5. Whether is it best to feed sheep or cattle with turnips?

A. Sheep are the most profitable, at least the farm will be in the best state of cultivation.

Q. 6. Is there any improvement in the construction of the turnip bin?

A. Yes;—to make the bottom with bars, thus ┼┼┼ and not close. The bars are a check to the turnips, by which cattle get a better hold of them, and the dirt and rain fall down between the ledges.

X. *On Sheep.*

A perfect breed of sheep should unite, 1. Form. 2. Fleece. 3. Fat. 4. Flesh. And 5. Flavour. It is possible that the Merino breed may be so improved, as to unite all those properties. It is much in their favour, that owing to the great value of their fleeces, they might be kept to a proper age, by which the mutton they produce is likely to become better calculated for weak and delicate stomachs, than when brought to early maturity, and rapidly fattened.

* If the horses went out and in the stable, and yard, as mine do, they would make full twenty loads of manure more in a year, than they will do as proposed in the question No. 4. My horses are not confined in the stable, except when the men are feeding them with chaff and corn.

XI. *On Dibbling Wheat*

The mode of dibbling wheat in Norfolk is well known. It is best on clay, loam, or mixed soils. Let the layer be ploughed up with a Leicester plough, (which will take the flag up level, and only nine inches wide), then make one row of holes on a flag, three inches distant, and put four or five kernels in each hole. And the holes should be filled up by a gate, drawn full of thorns, passed over the field the same way that it is ploughed. The land should be rolled previous to dibbling with a heavy roller. If the holes are made of a good depth, and the seed well deposited, this may be a good plan, but it ought to be done early in the autumn: it is tedious, and takes a long time. The drill husbandry is quicker, and will answer better, if properly executed.*

XII. *On preserving Turnips.*

The turnips in Norfolk, even the Swedish, received much injury from the frost, especially those which stand out of the ground. There is a mode that has been tried to prevent this damage, by pulling them up in November, and ploughing the land; then taking a double-breasted plough, and making a deep furrow and depositing the turnip, leaving the top out; then mould them up with the same plough. The expense of the labour of depositing the turnips, is four shillings per acre. This is a good plan, and prevents the frost from injuring the turnips, but is too tedious to be executed on a large scale.

XIII. *Course of Crops.*

The rotation of crops adopted in the neighbourhood of Holkham, is either a rotation of four, or five, or six.

Rotation of four crops.	*Rotation of five crops.*	*Rotation of six crops.*
1 Turnips.	1 Turnips.	1 Turnips.
2 Barley.	2 Barley.	2 Barley.
3 Clover.	3 Clover.	3 Clover.
4 Wheat.	4 Pasture.	4 Pasture.
	5 Wheat.	5 Pease.
		6 Wheat.

* The Rev. Dixon Hoste considers dibbling to be a slovenly process, and by no means to be

The rotation of four is accounted bad for the landlord, and in the opinion of Mr. Money Hill, will not be found profitable to the tenant in a lease of 21 years.

Half the farm has annually a white straw crop, and from the frequent repetition of the crops of grain, they are not so productive. Besides which, under that system, the quantity of sheep and cattle kept is comparatively trifling. The best husbandry in Mr. Hill's opinion is the alternate use of the five and of the six crop rotation, because pease, which is a valuable crop when it does answer, it is ascertained will not succeed above once in ten years.*

XIV. *On converting the whole Straw of a Farm into Dung, and giving none of it to Cattle or Horses.*

The best farmers in Norfolk are decidedly of opinion that none of the straw raised on a farm ought to be eaten by stock, but the whole of it properly converted into dung. On this subject Mr. Money Hill states, the less straw that is given to cattle as food, the better for the farmer. The best method of making dung is to strew the yard daily with straw, in which cattle are fattening upon turnips or oil cakes. What little is eaten by the cattle may be of service to them, and is no injury to the farmer.

Lean stock kept in a yard, and foddered with straw only, will remain lean, and the manure thus made is of little value. Pease straw (if well got) may be given with advantage to plough-horses during the winter months in the stable, and to store sheep in the field; but the greater part ought to be made into dung. From the great scarcity of hay this season, pease straw will be found an useful substitute next winter; as to bean straw, it is not known in that part of Norfolk.

In regard to the proportion of a farm that can be manured by its own produce, when the whole straw of a farm is converted into dung, by cattle feeding on turnips, oil-cake, &c. it is ascertained that by this system a farmer may raise a sufficient quantity of dung for his turnip crop, if carried *fresh* from the yard; but on

recommended. It is better for pease than wheat, and is certainly better than sowing above furrow, which is the worst system of any. Farmers seldom hoe their dibbled wheat.

* The Rev. Dixon Hoste observes that fallows are now totally exploded in Norfolk, except where the land is full of spear grass. The best culture on strong lands, he thinks is, 1. Beans, 2. Wheat, 3. Coleseed, or Turnips. 4. Barley laid down with seeds. 5. Grass, and then beans, &c.

the contrary, if carted into heaps, and then re-carted unto the land, it will waste at least one half; consequently only one half the turnip crop can be mucked, and the remaining half must be made out by cake or some other auxiliary, at a great expense.

Mr. Hill's farm consists of twelve hundred acres of arable land, and his turnip land, amounting to two hundred and thirteen acres, he has this year manured with long dung, and he has remaining in his yard an overplus of manure sufficient for ten acres more: long dung is not so soon exhausted as short, which is very evident, as the succeeding barley crop is always better.

XV. *Miscellaneous Particulars.*

1. The Norfolk plough does not plough up layers so well as others; it is too short in the plat; it should be four inches longer, and less curved at the heels; the flag would then be turned over more entire, and it would lie in a more regular state. With this exception, the Norfolk plough is considered in that county the best yet invented for general purposes. 2. Mr. Money Hill remarks that all harrows should have round teeth; they keep themselves cleaner than the square, or any other shape, and work easier after the horses. The teeth of harrows for clearing land should be five inches long, and should have an inclination to the draught iron. For burying the seed, however, the teeth should have no inclination, but should stand perpendicular, and should not exceed four inches in length. 3. When horses are soiled, it is better to give them their green food in bins in the yard, instead of feeding them in a stable, which is apt to produce grease; but horses, it is said, never have that complaint, when fed out of doors.* 4. In many parts of Kent and Norfolk they have no racks, but feed their horses with cut meat, put into mangers. Where horses are fed in the stable with racks, it is a great saving to have cross bars, so as to prevent their pulling out or wasting too much hay. This is particularly necessary where the hay is short.† 5. It is supposed in Norfolk,

* Hence the advantage of what are called *Hammels* in Berwickshire, or sheds, and a court to each division, for feeding stock.

† Old horses in the Spring, if permitted, will pull in a few minutes all the hay out of the rack, eating only the hay of the finest quality, and wasting at least one half of the quantity given them. Mr. Money Hill therefore recommends, that no hay *uncut* should be given to working horses, in the Spring months.

that where the plants are thin, the wheat is more liable to mildew. 6. Wood-pigeons are particularly destructive to crops of grain, and it is hardly to be credited the quantity they devour. In the stomach of one wood-pigeon lately shot at Holkham Park, some hundred grains of corn were fouud.

XVI. *Memorandums regarding the State of Marsh Land, in Norfolk, and some Hints as to the neighbouring Districts.*

In travelling from Mr. Coke's sheep-shearing at Holkham, to Scotland, in June 1809, I was induced to call on two active and intelligent friends to Agricultural Improvement, (Admiral Bentinck, and the Rev. Mr. Morphew, Rector of Walpole), for the purpose of obtaining information regarding the state of a very valuable district in Norfolk, called Marsh Land. I reached Bentinck Farm (in the centre of his estate), where the Admiral occasionally resides to carry on his various improvements, on the evening of the 2d of June; my stay was unfortunately too short to enable me to make all the inquiries I could have wished, but I saw enough to satisfy me, that the district was of infinite value; and that though a spirit had been excited, and some progress in improvement had been made, yet that some time will probably elapse, before all that might be done could be accomplished.

The north or highest part of the district of Marsh-land, has been in a great measure acquired from the sea. A mound, known under the name of the *Roman bank*, is still entire, and remains an ample proof of the skill and energy of that celebrated nation. Great acquisitions have been made by Admiral Bentinck's father, and latterly by himself; and the Admiral has still some considerable embankments in contemplation.

The soil, which seems to be a deposit of loam from the sea, appears to be of the greatest possible fertility. Larches, and other trees planted by Mr. Morphew, only six years ago, had already reached a great size.—Asparagus, lettuce, and other garden productions, are of an uncommon size, and excellent quality: and the crops in the fields, *when drilled and properly cultivated*, cannot possibly be surpassed. It was probably owing to this natural fertility, that the farmers paid such little attention to their manure. The bean straw was often burnt by the poor, or by the bakers, instead of being converted into muck and dung, and when made into dung, often lay for years untouched in the yard.

The old mode of cropping was the common field system. 1. Fallow. 2. Wheat. 3. Beans; both these crops broad-cast. There was no clover, no turnips, and but a small proportion of grass.

The returns from the two crops they raised were very moderate, owing to the want of skill and industry in the farmer. Sometimes indeed they raised three crops of grain and pulse successively, and the returns then became still worse. The following is the highest calculation according to that system.

State of the Produce under the old System in a course of four years.

Year.		Value.		
1.	Fallow—no produce.			
2.	Wheat—seven coombs four bushels each	£17	10	0
3.	Beans, worth - - - -	5	0	0
4.	Wheat—ten coombs - - -	15	0	0
		£37	10	0

Total, only £37. 10*s.* for the four years, from which, rent, tithes, and taxes, the expense of cultivation, the maintenance of the farmer, &c. must be deducted; whereas, under a judicious system, the produce it will appear, may be raised to £69. 10*s.* making a difference of £32. in four years, or £8. per acre, per annum.

It is astonishing that a tract of country, possessed of such natural advantages, and in the immediate neighbourhood of so considerable a commercial town as Lynn, should be so backward in improvement. But it wanted, 1. Population. 2. Roads. 3. A proper system of cultivation. And, 4. A spur to exertion and industry.

I. *Population.*

Without labourers at moderate rates, no improvement can be effected. Admiral Bentinck has therefore judiciously begun his operation, with increasing the number of cottagers on his estate, on a system likely to be advantageous to them, and to the landlord.

II. *Roads.*

The utility of roads (for the improvement of which in this district, the public is so much indebted to Admiral Bentinck, and Mr. Morphew) cannot be questioned.

Till that accommodation was obtained, no stranger ever thought of visiting Marsh Land, (and in the term *stranger*, the proprietors of the land were in general to be included); nor could the farmers carry their produce to market, but with infinite difficulty, and at a great expense; the case however is now much altered: the roads are excellent; and by that circumstance alone, the value of the land is increased in value from one pound to two pounds per acre.

III. *Improved System of Cultivation.*

The best system of cultivation is still in its infancy, though a foundation has been already laid, by the exertions of Admiral Bentinck, whence the happiest consequences may be expected. The introduction of clover, of turnips, and of potatoes on a great scale, will be of inestimable consequence in a district, so capable of producing these articles in the greatest perfection. Drilling the crops of grain also, seems to be peculiarly well calculated for so friable a soil. But the great object, in a national point of view is, to raise great quantities of hemp, and flax, not only in this, but in the neighbouring districts, where it is said, that a considerable portion of fertile soil, exceeding half a million of acres, might be employed in producing these important articles.

In the parishes of Upwell and Outwell, indeed, hemp and wheat in succession, have been accounted, for at least half a century, to be the very best mode of farming.

According to the present prices of hemp, it is much more profitable than wheat. Nothing tends more to clean the land than a crop of hemp; and in regard to the succeeding crop of wheat, it is said to be greater in quantity, and better in quality, than under any other rotation.*

According to that system the following returns are obtained in a succession of four years:

* In the excellent survey of the Hebrides, by the late Mr. James Macdonald, it is observed (p. 276.) that he saw hemp in a small tenant's possession in South Uist, where he little expected such a phenomenon. It stood in a belt nearly six feet broad, round a cabbage field. The owner gave as the reason, *that hemp effectually guards cabbages, and every sort of pulse, against caterpillars and all vermin, and that he uniformly found it a complete protection for his garden in that respect.* It would be well worth trying whether belts of it would not prevent the fly in turnips.

Year.			Value.
1.	Hemp	40 stone at 8*s.* per stone - -	£16 0 0
2.	Wheat	7 coombs, at 50*s.* per coomb -	17 10 0
3.	Hemp	40 stone at 8*s.* per stone - -	16 0 0
4,	Wheat	8 coombs - - -	20 0 0
			£69 10 0

In regard to flax, when it is suffered to go to seed, it is supposed to be one half more valuable, at the present prices, than hemp. It is an additional advantage, that when either flax or hemp is dried upon clover lay, or any other sort of grass, after being steeped, it amazingly increases its produce.*

The cultivation of flax and hemp in this and the neighbouring districts, to the extent of which it is capable, is perhaps the greatest national object, to which the attention of the public can be directed at this time; for it would render us independent of other countries as a naval and a manufacturing nation,† without diminishing, under a proper system of management, either a blade of grass, or a pickle of corn.

Besides hemp and flax, mustard, canary, woad, madder, rape, &c. might be cultivated on so rich a soil, with infinite advantage.

IV. *Spur to Exertion.*

As soon as the farmers are properly roused, and determined to become industrious, they should be animated to industry, by leases of 14, if not 21 years; and, next, by the demand of an adequate but not an exorbitant rent; for without some stimulus, they may become as careless and slothful as their predecessors. Every means also should be taken to render the country healthy, and free from those disorders to which low level tracts are apt to be subject; but which by a little

* It is said that the bad quality of any pit of water may be improved, by steeping hemp or flax in it, but it must not be used till the succeeding year. This is effected by poisoning the small shrimps and lobsters that breed in fen waters.

It is not yet ascertained, whether steeping flax or hemp in the salt or brackish water in the lower parts of marsh lands, has any bad effect.

† The linen manufacturers can never thrive either in England or Scotland, if flax must be imported from abroad; and from those districts, Ireland might be supplied with flax seed instead of from America.

attention, in particular by filling up, or frequently clearing the ditches, can easily be prevented.* Steam engines would be the most effective power for that purpose, and by them, Walcheren itself might have been rendered healthy.

Conclusion.

On the whole, there is every reason to believe, that in the lower parts of Norfolk, Cambridgeshire, the Isle of Ely, and Lincolnshire, there is a tract of country, containing it is said above half a million of acres of land, rivalling Flanders in fertility, which, were it brought into as productive a state as might be the case, would soon become one of the principal sources of wealth, and of naval strength, that the nation is possessed of. What an absurdity, to bend so much attention to distant possessions, when we have such a treasure within our reach!

* Admiral Bentinck states, that the health of Marsh Land depends entirely on the *will* of the inhabitants —There are too many ditches.—If every parish were to have *one* or two, or more main drains deep and wide (and even navigable for boats), with small grips for carrying off the surface water, leading into the main drains, nothing like stagnate water would remain; whereas now, to keep the cattle and sheep from their corn fields, the practice is, to divide every thing by ditches, which in summer, it isdifficult to keep full of water. However, the health of Terrington, and some of the neighbouring parishes, has never been doubted, and the marshes, on the whole, are as healthy as any part of England.

No. XXIV.

A Memorial upon Irrigation, by David Shank, *Farmer and Tenant in Low Curgbie, Wigtonshire, in Claim for the Silver Medal, Premium* No. IX. *of* 1809.

In the district wherein the claimant for the Premium resides, viz. the Rhins of Galloway, irrigation is not practised by any other farmer, and little or imperfectly by any proprietor.

His attempt, or experiment, commenced in November 1809, in a small field admirably adapted for such an operation. He had adverted to the peculiar situation of the field for several years; and although the land is well adapted for tillage, yet as grazing is a great object in this country, it occurred to him, that this small field, converted into a water-meadow, would be of essential value to his farm. In spring 1807, therefore, after the field had been richly prepared by a drill-green crop, he laid it off in ridges of 30 feet wide. It was then sown with barley and grass seeds, and in the centre or crown of every ridge or furrow, was drawn by a water-furrow plough, in order to suit the purposes of irrigation in after years. The barley was more luxuriant than productive, and the grasses yielded well, but a considerable part was cut and used green for horses, as soiling in summer 1808. The tenant conceived, that it would be proper to allow the land to consolidate for another year before admitting the water, and accordingly, a crop, partly for green food, and partly for hay, was taken in 1809. This crop, however, was considerably inferiour to the former, and in the end of October or beginning of November 1809, the long proposed irrigation commenced. A dam-dyke of turf, the most simple of all materials, was constructed at the lower end of a glen or dingle, upon the upper side of the field, and an easy level was found for a feeder across the field. This, by means of stops, conveyed the water into the centre furrows before described, and thus the water was distributed over the surface.

The rivulet being small, it was only after falls of rain that irrigation was complete, more particularly as the subsoil is very porous; but every attention was paid

so as to obtain the greatest possible benefit. The process was continued until about the middle of March, and a second dam was constructed half way down the field, so as to give the lower part as much advantage as the upper. The spring is late in this country, but this little field exhibited an early verdure far surpassing any thing in this neighbourhood. Part was cut for soiling, being earlier ready than any sown grass; but the greater part was allowed to stand for hay.

April, May, and the first half of June 1810, consisted of dry and unkindly weather, so that grass of all kinds was extremely backward.

In this same field there are several little eminences, which could imperfectly, if at all, receive benefit from the water. These, together with the porous subsoil, upon which almost the whole field is incumbent, admitted the injurious effects of this long continued drought, and of course the crop was considerably shortened of what might once have been expected.

By the certificate accompanying this statement, four acres, Scots statute measure, were under irrigation, and two roods, nine poles, were too elevated to receive much advantage therefrom. Before the end of June, however, the hay was cut, and as soon as the weather would permit, ten ricks were secured. These ricks averaged 76 stones, each of 26lbs. averdupois per stone, and it was calculated that not less than 100 stones were consumed green. Thus, the produce will amount to not less than 860 stones, or about 10 tons, being at the rate of 190 stones, or more than 2 tons per acre. This exceeds, very considerably, the produce of 1809, and the field is reserved for the purposes of annual irrigation, all parts where the water cannot properly extend, being now richly dunged. These parts, however, are trifling, when compared to the whole extent.

This land, before irrigation began, and in its improved state, might be worth 45*s.* per acre upon lease. Hay, in this country, is well worth 6*d.* per stone to the farmer.

The aftermath or foggage has been worth 20*s.* per acre; so that the field in question can scarcely be managed in any manner so profitably as by the means recently adopted.

The water was shifted from side to side of the field, according to the advice of the English irrigators, so as to dry and drown the land alternately, but one small hollow was unavoidably under water all the time,—say about four months and a half, and here the grass was by far the most luxuriant. It wou'd appear, that in

England this might have been prejudicial, but the different effect may have been produced by an essential difference of climate. Something may also depend on local situation, the cool sea breezes tending to prevent that putrescence of the water and herbage upon the surface, which is understood to take place in a warmer and inland country, when irrigation remains uninterrupted beyond a certain length of time.

The expense of irrigating this field is exceedingly moderate. The two drains and feeders could not cost above 30s. and the subsequent operations can scarcely be reckoned on, as they afforded amusement to the occupier, who conducted them with his own hand.

Rye grass, clovers, and rib grass, were the seeds sown. The tenant was aware that natural and meadow grasses might have been more advantageous, but he has already the satisfaction of seeing these rapidly introduce themselves; and although without pretensions to knowledge in botany, he apprehends these sweet natural grasses chiefly to consist of *Poa pratensis* and *Poa trivialis.*

Kirkmeridan, January 7, 1811.

We, Patrick M'Master, in Clonyard, and Edward Kerr, in Kilstery, farmers, do certify and attest, that the foregoing Memorial contains a fair and correct statement of facts, according to the best of our knowledge and belief, we having had many and frequent opportunities of inspecting the field therein described, and the produce obtained therefrom.

(As witness our hands) PATRICK M'MASTER.
EDWARD KERR.

Logan, January 7, 1811.

I have read the foregoing statement respecting the field in irrigation, and believe it to be correct.

ANDREW M'DOUALL, J. P.

Low Curghie, December 31, 1810.

I, John Scott, gardener and land surveyor, have this day measured a field under irrigation, occupied by Mr. David Shank, tenant of this farm, and I find the

whole contents of the field to be four acres, two roods, nine poles, Scotch statute measure, whereof the two roods and nine poles very nearly consist of detached pieces too elevated to receive the water, and the four acres Scots, being a fractional part more than five acres English, have been completely and successfully irrigated.

(As witness my hand) JOHN SCOTT.

☞ The Silver Medal was awarded.

No. XXV.

The Treatment and Produce of a Field of Lucern. By Mr. Rodwell, *of Livermere, near Bury St. Edmonds.*

In a field containing eleven acres of old arable land, of a dry light soil, about twenty inches in depth, upon a stratum of gravelly clay, I had barley sown after a clean fallow in the spring of the year 1807; with it there were sown 20lbs. an acre of lucern, broad-cast, and harrowed in with the barley, as is usual in the treatment of clovers or other artificial grasses. An average crop of barley was produced; the lucern did not make any considerable progress till the spring of the following year 1808, when a good plant was apparent, the growth was sufficient to afford me a mowing in the spring of this year, after which I had it manured with soot, at the rate of about thirty bushels per acre; the growth was afterwards more rapid and luxuriant, and it produced me two other crops in the summer and autumn of this year. I found it necessary to be particular in my hoeing or rather digging up, and keeping it clean of all perennial plants, such as docks, thistles, &c. which during the year cost me forty shillings.

Early in the spring of 1809, I had five acres of it manured with a compost of earth, and farm-yard dung: the benefit arising from it was evident. On the 23d of May I commenced the first mowing, the produce of which given in binns, in a yard well littered with straw, supported me thirty horses seven weeks, with the assistance of two and a half quarters of oats per week during the time.

After the first mowing I had it again manured with soot, at the rate of about thirty bushels per acre as before, and here I had an opportunity of witnessing not only the great improvement arising from this kind of manure, but its great superiority over the compost made use of in the spring.

The second mowing was begun on the seventeenth of July, the produce of which was sufficient for the feeding of twenty horses during seven weeks, without the necessity of resorting to any other kind of food. On the first of September I

had a sufficient growth for the commencement of the third mowing, which with the assistance of ten quarters of oats fed me twenty horses during six weeks.

The spring of the year 1810 having been very cold, the growth of lucern was consequently slow, nor was it till the sixth of June that I began to mow; its production however was so considerable as to induce me to weigh the produce of an acre, when perfectly free from either dew or rain, and I found it equal to thirteen tons. The produce of this mowing maintained me thirty-five horses eight weeks, with an allowance of one bushel of ordinary oats each horse per week: the second mowing was begun on the 15th of August, and the production nearly equal to the first: the third in October, but owing to the lateness of the preceding mowings, it was rather light, although at that season of the year extremely useful.

I have here particularized the rapid production, the disposal and usefulness of this valuable plant, and which I trust ere long will be more generally brought into cultivation, particularly as will be seen by this, that it is much easier to be obtained than is generally understood; and I have only to add it promises a continuance of seven years.

It has kept my horses during the time they were fed upon it in good condition, although always in full employ, and in good health during the whole of the year; and the offal arising from the horses has kept me a considerable number of pigs, besides affording an opportunity of converting a large quantity of straw into excellent manure.

An Estimate of the Expenses and Produce of Eleven Acres of Lucern.

DEBTOR.

		£.	s.	d.
1808	The expenses of the seed and sowing, to be divided into a proportion for each year, supposing it to stand 12 years, is 2s. 6d. per acre per annum - - - - - - -	1	7	6
June.	To dressing with soot 30 bushels per acre, at 1s. per bushel, and 2s. 6d. per acre sowing - - - - -	17	17	6
	To hoeing and cleaning - - - - - -	2	0	0
Michs.	To rent of land at 20s. per acre, rates and taxes at 5s. per acre (Not tytheable, being used for feeding horses used in husbandry.)	13	15	0
	To three mowings, at 4s. per acre each - - - -	6	12	0
	No expense in carting from the field to the yard, as it was done by a horse after he had performed his day's work, and men who would otherwise have been employed in feeding them with chaff and corn.			
		L 41	12	0
1809.	To the proportional part of seed and sowing - - - -	1	7	6
March.	To 5 acres manured with compost, at 60s. per acre -	15	0	0
June.	To dressing with soot the whole field, at 32s. 6d. per acre	17	17	6
	To rent, taxes and rates, at 25s. per acre - - - -	13	15	0
	To three mowings, at 7s. per acre each - - - -	11	11	0
	No expenses in hoeing or cleaning.			
	Balance being the nett profit, at 11l. 1s. per acre -	121	11	0
		L 181	2	0
	The value of the manure made from thus feeding the horses in a yard well littered with straw, was very considerable.			
1810.	To the proportional part of seed and sowing - -	1	7	6
March.	To a chaldron of lime applied to an acre (no apparent benefit)	1	10	0
June.	To dressing five acres with soot, at 32s. 6d. per acre -	8	2	6
Michs.	To rent, rates, and taxes, at 25s. per acre - -	13	15	0
	To three mowings, at 21s. - - - - -	11	11	0
	Balance being the nett profit, at 12l. 1s. 8d. per acre	132	17	0
		L 169	3	0

N. B. Quantity of manure made this year was 300 loads of forty bushels to the load; it afforded an opportunity of making more, had I had more straw or rubbish to convert to that purpose.

CREDITOR.

			£.	s.	d.
1808.	Having no memorandum, not able to credit the account of this year's produce, but am certain of its being worth more than adequate to the expenses incurred.				
1809.	By cost of keeping 23 horses, 20 weeks, at 9s. per horse per week, (which is an average price of keeping working horses upon chaff and corn, as my situation affords them nothing else, having no grass land)	207 0 0			
	Deduct for oats consumed during the time 28 qrs. at 24s. per qr. - -	33 12 0	173	8	0
	By value of offal to cows and pigs -		7	14	0
			L 181	2	0
1810.	By cost of keeping 28 horses, 18 weeks, at 9s. per horse per week (as before stated)	226 0 0			
	Deduct for 67½ quarters of ordinary oats at 20s. per quarter - -	67 10 0	158	10	0
	By value of offal to cows and pigs .		10	13	0
			L 169	3	0

Livermere, near Bury St. Edmonds,
21st March, 1811.

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COMMUNICATIONS

TO THE

BOARD OF AGRICULTURE;

ON SUBJECTS RELATIVE TO

THE HUSBANDRY,

AND

INTERNAL IMPROVEMENT

OF THE COUNTRY.

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1813.

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COMMUNICATIONS, &c.

No. XXVI.

Observations on Peeling Oak Timber. By Mr. John Farey.

To the Right Honourable Sir John Sinclair, *Bart. President of the Board of Agriculture.*

SIR,

IN compliance with your wish to receive some account of the process of peeling Oak Timber in Bedfordshire, and of the use of the set of *bark-peeling* tools, lately received from His Grace the Duke of Bedford's Agent, Mr. Robert Salmon, and lodged for inspection in the Repository of the Board :* I beg first, to advert to the great price which oak-bark bears at present, compared with what it fetched some years ago, and to the propriety of using greater care, to preserve every part of this highly useful and valuable article, than was judged necessary, when the processes and manner of peeling and conducting the bark harvest was established, which still prevails in several counties of England. To those accustomed to the care and exactness with which coals, potatoes, and many other bulky articles are weighed, and the quantities ascertained previous to sale, in all the northern parts of England, and hay and straw, &c. in Middlesex, it will seem surprising, that an article like oak bark, of more than twice the value per ton, compared with many of these, should continue to be sold in numerous districts, by methods too vague and uncertain, to be applied to almost any article that is sold, even manure, which is now commonly sold by the ton in different counties; weighing-engines, to be used for hire, being erected at the entrances of many large towns, as at Ashborne

* The tools may be had at Mr. Hill's, Agricultural Implement Maker, 422 Oxford-street.

in Derbyshire, and where all dung, ashes, &c. is regularly weighed out to the purchasers.

A first step towards increasing the quantity of bark, is to introduce the sale and delivery of it to the tanner by weight, ascertained by portable steel-yard machines, accurately made and adjusted, used in the woods at the time of loading (such as I introduced in Bedfordshire in 1793, and continued always to use, till after the death of the late Duke of Bedford) or at the public weighing-engines on the turnpike roads, if such are not yet erected in the towns and large villages for hire, as will, I hope, in time be generally the case;* and to pay the labourers for peeling the bark by this weight, whereby it is rendered their interest, to peel every bough to the utmost, and save every piece of the valuable bark wasted, for want of turning the trees or their large arms, and on the falling and lopping chips, in almost every district where I have examined the operation of bark-peeling, and the men are not paid by weight; but particularly, if they are paid by that most absurd and vague method, of ascertaining the quantity by the yard-set or fathom in length of a ruck or range, which it is past the art of the most intelligent and careful, to make at all uniform in quantity in different cases, of thicker and thinner bark, larger or smaller trees, or when such are free of knots or otherwise; or when owing to the weather the bark runs freely or otherwise, so that the bark can or cannot be taken off in pieces equally large: and when to all this, the difference of care and skill in the peeler, in nicking his bark into such lengths as it can be clean peeled, without tearing at the ends or sides, peeling the boughs high, or otherwise, and care in peeling the parts first where he is about to chop off the tree or its arms; and at length, his design and dexterity in setting up a showy stack of bark, or his bungling carelessness on the other hand, introduces such a complete uncertainty, as would render this method improper to be used for articles even of a quarter of the value per ton or per cubic yard in a close stack,† that bark now has. Selling tea or other

* Would it not, I submit, be a proper subject for a medal, as an honorary distinction to those gentlemen, who within a limited time, erected and let or made arrangements for the public use, on easy terms, of large weighing-engines in populous districts?

† This method, by the cubic-yard, will be found a good one to sell by, when gentlemen adopt, the only practice which can ensure the obtaining a full and market price for any article, viz. the grower or maker having it stored and preserved, so that he can bring it to market by degrees, and at different seasons, according to the consumption and demand; that of having their bark as minutely and as carefully attended as their hay and corn, and dried, stacked, and securely thatched top and sides, or stowed in close barns, on their own premises, and at length, if necessary, employ

valuable articles by the handful, or by poising them in the hand, would scarcely be less uncertain or improper, than this yard-set of bark, as can only be fully known by inspecting the weighing of a great number of yards of bark, set up by different men in different situations; and this is also a proper preparative step, to the introducing the peeling and selling by weight: let the men peel and set up the bark without any intimation of your intention, let the tanners inspect it, and hear their objections, or otherwise, to the set being fair or as usual, and then weigh the whole (as I did the Duke of Bedford's in 1793) or a considerable portion of each sort and in each situation, fairly selected in the presence of the peelers; and on settling with them, calculate and state in writing to the foreman of each gang or set of peelers, how much his work comes to, calculated by yards at the price agreed on as usual, and how the same total amount is made out, by a price (or prices) per ton, hundred weight, or kintal (of 100lb.) on the weight ascertained or calculated from such average weighings; at the same time giving notice to the men, that previous to the next bark season they would be expected to agree, for the peeling by weight instead of measure: a similar calculation and notice may also be made and given to such tanners as are regular customers, as to selling by weight: and in this way the change may be effected, without any improper increase of wages, but a considerable diminution, when the plan is fairly established and understood; and the future selling, at prices proportionate to the London or other principal public markets, will be also facilitated.

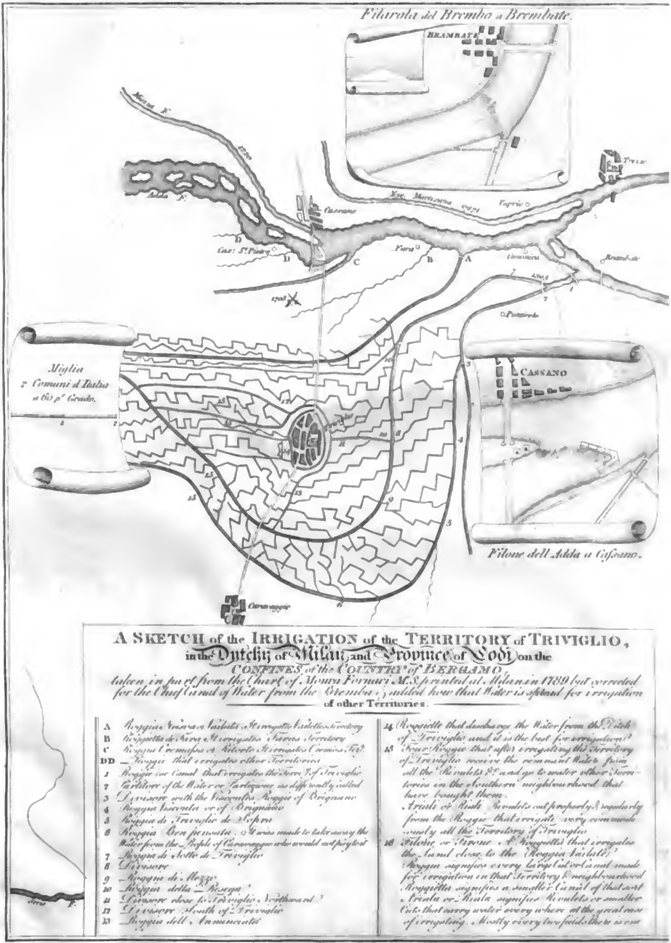
Not seeing reason to approve the peeling of trees standing, as is generally practised in the middle and northern part of Derbyshire, and several other districts, I would recommend, that a spade be always used, previous to beginning to

shavers (who might easily be trained among their own labourers) to shave, hatch, and bag their bark, in which state its market value is as easily ascertainable as a sack of flour, or any other article of commerce.

What, I ask, would be the condition of the farmers of England, if they had confined their attention to the growing of grass and corn, without providing the means to gather, store, and preserve it? but in the same week, and almost on the same day, they were in every place obliged to send for the corn-dealers or millers, and ask them what they would give for their ripe standing crops, which their improvidence had thus left at the buyer's mercy? And yet, what does this differ from the case of a large portion of the bark-growers in England? who too generally leave it to the buyer to employ and pay the men who peel and ascertain the quantity of their bark, or to supply large and often repeated potions of ale to the men they may so employ.

chop an oak down, and that the moss, leaves, and earth be carefully cleared from the bottom of the trunk and the spurs or beginnings of the roots, and that each tree and spur be chopt or nicked round by a sharp hatchet, as low as ever the chopping for the falling is intended to proceed; and that proper vertical scores or nicks be made therefrom, with the point of the bark-tool, or of a bill, and that two lengths at least of the bark above this nicking, be taken off, by the largest tool, fig. 1. in the annexed Plate (the curvature of which is shewn by the side view in fig. 2), using both hands; and it were better by using a stool or ladder a yard long, to take three lengths clear off, before the falling commences: discretion being used in choosing the direction of the fall, as far as valuable arms, and the continuity of other trees will permit, that the tree does not apply too close along on the ground in its fall, which is best prevented by its falling on a number of midling sized arms, that may break its fall: a small heap of earth laid by a spade, on which the peeled part of the body may fall, will also greatly contribute to keeping the tree from the ground; and after all, ample levers should be provided for turning all such trees as require it, during the barking of their trunks, or to release and draw out the arms stuck into the ground.

Those who have attended to the operation of shaving, which all oak bark (except of underwood or the youngest saplings called white or maiden bark) undergoes before the tanner can use it, must be aware of the great importance of having the bark in proper sized pieces, and their ends and sides always chopped, nicked, or scored, and not torn into threads, as too frequently happens, and when also it will generally be found, that a part of the inner and most valuable of the bark is left adhering to the tree, and wasted: great attention is therefore necessary in nicking the bark into proper lengths, by a sharp hatchet on the trunk and larger arms, and by a light sharp bill on the boughs, chopping upright, and not very slanting, with respect to the surface of the bark, as is too often done; by which the best of the bark is exposed in a thin edge, to be infallibly spoiled if set up with this end on the ground; and the ends of the bark are not loosened from the tree and the peeling facilitated, as they are by a perpendicular nick, quite through the bark, conducted over the center of boily or pin-knotty places, and to the insertions of the arms, as much as possible, so as to divide the bark quite through, into such pieces as will come off with the greatest ease to the peelers, which is, I am satisfied, the best rule for the tanner and the bark grower also, having little regard to uniformity, in the lengths



A SKETCH of the IRRIGATION of the TERRITORY of TRIVIGLIO,

in the Dutchy of Milan, and Province of Lodi on the CONFINES of the COUNTRY of BERGAMO,

taken in part from the Chart of Mons.r Fornari M.S. printed at Milan in 1789 but corrected for the Chief Canal of Water from the Brembo; added how that Water is obtained for irrigation of other Territories.

A Roggia Vailata Vailate. It irrigates Vailate Territory
B Roggetta de Fara. It irrigates Fara Territory
C Roggia Cremasca & Rivolta. It irrigates Cremasco Terr.y
DD Roggie that irrigates other Territories
1 Roggia or Canal that irrigates the Terr.y of Triviglio
2 Partitore of the Water or Partigione as differently called
3 Divisore with the Vicinales Roggia of Brignano
4 Roggia Vicinales or of Brignano
5 Roggia de Triviglio de Sopra
6 Roggia Bon fornaleo. It was made to take away the Water from the People of Caravaggio who would not pay for it
7 Roggia de Sotto de Triviglio
8 Divisore
9 Roggia di Mezzo
10 Roggia della Brugna
11 Divisore close to Triviglio Northward
12 Divisore South of Triviglio
13 Roggia dell Annunciata
14 Roggetta that discharges the Water from the Ditch of Triviglio and it is the best for irrigation
15 Four Roggie that after irrigating the Territory of Triviglio receive the remnant Water from all the Rivulets &c and go to water other Territories in the Southern neighbourhood that have bought them.
Arioli or Rioli Rivulets cut properly & regularly from the Roggie that irrigate very commodiously all the Territory of Triviglio
16 Filone or Tirone. A Roggetta that irrigates the Land close to the Roggia Vailate
Roggia signifies every large Water Canal made for irrigation in that Territory & neighbourhood
Roggetta signifies a smaller Canal of that sort
Ariola or Riola signifies Rivulets or smaller Cuts that carry water every where at the great use of irrigating. Mostly every two fields there is one

or widths of the pieces, except on the very clearest parts of the trunk and large arms; but so that each piece may be solid and entire, with nickt edges and ends, and not torn, or hammered above all things, which causes the bark to spoil under each blow,* or spend itself, as the tanners call it, as effectually as apples or pears spoil, when bruised in the gathering. But how can tearing and hammering be abolished? in particular cases and seasons, in the use of the yard-set, where the labourer feels little or no interest (except in the ale or the fees of the buyer, in too many instances) in pieces less than three feet long, or two at least, for which only he is paid, when set up, with an art much more studied, I fear, than any others in this important department of rural management.

The most experienced and careful peeler in a gang should be employed in cutting off the arms and boughs, taking care always to peel the place first, unless a single cut can sever the bough, that the bark be not wasted on the chips; and the greater part or all of the nicking would best be done by such person, at least until the principles and practice above recommended were perfectly understood by the rest of the gang. Women and boys, whom it is so very desirable to employ in peeling the smaller arms and boughs, with the tools fig. 4 and 5, used with one hand, ought perhaps, always to have their bark nickt for them, both to avoid the expense and trouble of so many tools, and accidents with them, as well as to have that essential part well performed.

In peeling the bodies of small spires and the arms of trees, the tool fig. 3, that can either be used with one or both hands of a stout man, will generally be found the most useful; all these tools should be kept very sharp, and without a perceptible bevel on the flat side, and care taken in forcing them in between the bark and the wood, always to apply the iron as flat as possible to the wood, so as neither to cut the wood or the bark, but simply wedge in between them: the turning motion of the handle must also be carefully made, for wrenching off the bark, so as never to break it by the edge of the tool, which has many of the bad effects on the bark with tearing and hammering.

The tools represented in fig. 6, 7, 8, and 9, were sent up from Chatsworth, in Derbyshire, by His Grace the Duke of Devonshire's Agent, Thomas

* I lament to see any fresh currency given to so mischievous an idea, as that of beating the boughs of oak trees with a mallet while held on a large stone, "until the bark be split!" this cannot be too strongly reprobated.

Knowlton, Esq. of Edensor, from whose letter of the 28th of May, 1811, I beg particularly to recommend the following extract to your notice, viz.

" The oak in this part of the country, is all stripped standing, except very large trees that the men cannot climb, but that is a circumstance which very seldom happens.

" The tools that I sent up to you are used in the following succession; the smaller bone (fig 7), which is from the fore leg of an ass, between the knee and the shoulder, is used for the smaller branches and tops of the trees, for which it is better than the iron, which is apt to run through and tear the bark. The bone of a red deer is preferred, when it can be procured. After this as the branches grow stronger, the smaller iron (fig. 9.) is used; then the larger bone (fig. 6.), which is that of a horse, is used; and lastly the large iron (fig 8.), is employed to decorticate the rough trunk of the tree near the root. How far this practice extends to the northward, I do not know, having since I came here been so fully occupied by my English and Irish agencies, as to prevent all excursions of observations, or pleasure. I apprehend it does not extend far into Nottinghamshire. About Derby, the trees are cut down before they are barked; but to the northward, through all the West-riding of Yorkshire, the trees are decorticated standing; and it is also the practice of those parts of Cheshire and Lancashire, that border on Yorkshire and Derbyshire.

" In the East-riding of Yorkshire, the trees are all cut down first, and also all round York, as far as the plain extends, and irons only are used, except when the men have none; then they shape a piece of oak like an iron, and make use of it, as a bad subsitute. In the south of Ireland they use the small iron (as there are no large trees) and pieces of wood sharpened. And so ill is this business managed, that they continue barking through the summer; and when the sap has ceased to run, they beat the bark with clubs to get it off, which every body knows spoils the bark. Three years ago the price of bark in that country was 20 guineas per ton, if good."

On the above I would beg just to remark, that the necessity of using a bone, to prevent the iron (fig. 9) from running through and tearing the bark, seems to me to arise wholly, from the want of a proper curvature in the operative part of the iron: since in Bedfordshire, where all the tools curve, more and more as they become smaller, and are in a degree adapted to the curvature of the tree or

branch they are to be used upon, this serious inconvenience is not at all experienced.

Except perhaps in the most settled weather, the pieces of bark, as they are peeled and laid about on the ground to dry, ought never to be laid with the flesh side upwards, but laid as hollow as possible with the race upwards, because, the least rain falling on the inner bark, dissolves and wastes part of its tanning principle; and I cannot think, that the sun shining hot on the newly peeled surface, has a beneficial effect, hardening only the surface, and perhaps retarding the future slow and effectual drying through, which is essential to the preservation of bark, without mouldiness, one of its greatest evils; the destructive effect of parasitick fungi, being here as evident and as deplorable, as in all other cases, but of which too few are fully aware.

I would strongly recommend the abolition of the practice of setting the ends of an article, so very perishable as bark is, on the damp ground, and among tall grass, as too often is done, and because the drying of a closely set ruck or range of bark, is far less facilitated by the wind and air, than when it lays nearly horizontal at 18 inches or 2 feet above the ground (as I have always practised since weighing was introduced) either on two parallel rows of poles, supported on crooks or forked sticks let firmly into the ground by an iron crow (driving without, being seldom sufficient) or on one row of such poles near and parallel to the trunk of a tree that was fallen and peeled, but either a little higher or lower than it, that the bark may lay a little inclined, the better to shoot off the rain. When high winds occur, or deer or other cattle are unavoidably admitted to where bark is drying, too much attention cannot be paid, to prevent their tossing or rubbing it down, and to replace all which is so thrown on the ground, in the night; and in case of a showery damp time, it will be right to relay the bark, on the occurrence of a fine day, to prevent the moulding of any fleshy parts in contact with each other, or the tree, which ought however as much as possible to be avoided in the first stacking of it.

The bark, when sufficiently dry to house, has the ends of thick fleshy pieces, in the middle as well as outside, so hardened, that the thumb nail will not penetrate it, or with much difficulty; the fleshy side being of a light brown and uniform colour, without tendency to mouldiness; and thus it will keep, if carried in fine weather, for one, two, or even three years or more, without the loss of its quality,

If the top and sides are close thatched, or in a close boarded barn; and without loss or weight also, as I have determined by several considerable trials, in most of which there was a gain of weight after long keeping, as might have been expected, from considering, that bark often is, and ought always to be carried in hot sunshine, that the humidity of the air will generally cause some increase of moisture in the succeeding winter; a thing which the bark owner should never covet, by admitting damp air, but exclude the same as much and as soon as possible, after stacking in good order.

To some, who have been accustomed to make considerable sums of their bark without much trouble, these precautions will doubtless seem unnecessary; and some, without thinking, may perhaps be disposed to say, that the tanner, and not themselves, bears the losses, if any, of these want of over carefullness; ask, however, any good farmer, why he takes such care and pains to house his wheat and other grain in the most perfect order, and in every subsequent operation, in order to make it handle and look well, and he'll never tell you that the loss of a contrary practice would fall on the miller who grinds it; knowing from weekly experience that his prices at market are decreased, doubly and, trebly or more, from the want of these niceties, to the real injury the grain may have sustained; and so it is with the bark-grower, who has torn, hammered, or mouldy bark to dispose of, he may rest assured: and whose timber also suffers in its general value, from dead knots and decays, or useless top, left on it, and measured with it, in a like multiplied ratio, to the real defects; strongly pointing out the necessity of early pruning all timber trees, on Mr. Pontey's improved principle, and constant attention to prevent knots and rotten side boughs (and which produces clear bodies of excellent bark also) since by an expertness in discovering such defects, and magnifying their extent, and in availing themselves of allowances of measure, and deductions in bargaining, as well as in the measuring of trees which taper fast owing to arms and knots, the best, though least fair of the profits of timber dealers, are known to consist; and which it would be vain to argue, are less certainly taken from the profits of the timber-grower, than if the process was more direct and visible. I am, Sir,

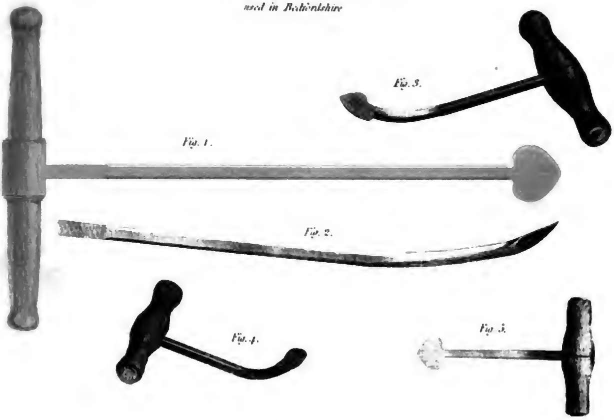
Your obedient and very humble Servant,

JOHN FAREY, Sen.
Mineral Surveyor.

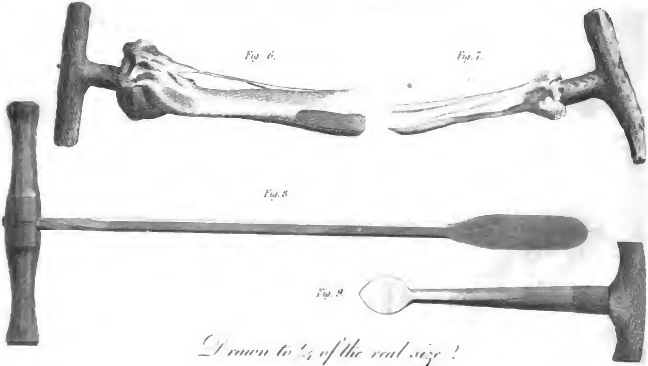
12, Upper Crown-street, Westminster,
1st June, 1811.

BARK PEELING TOOLS

used in Rutlandshire



TOOLS EMPLOYED in DERBYSHIRE



Drawn to ¼ of the real size!

Drawn by J. Farey Junr.

These Tools may be had at Mr. Hill's, Agricultural Instrument Maker, No. 422 Oxford Road, London!

P. S. The dimensions of the several peeling tools may be correctly ascertained by the scale affixed to the plate of my son's drawings; and it may be proper to add here, that the several tools weigh as follows, viz.

		lbs.	oz.
Fig. 1.	The large Bedfordshire body-iron	2	9 avoirdupois.
3.	The small ditto	0	12
4.	The large Bedfordshire bough-iron	0	6
5.	The small ditto -	0	5
6.	The large Derbyshire-bone -	1	2
7.	The small ditto -	0	7½
8.	The large straight Derbyshire iron	2	12
9.	The small ditto	0	7

APPENDIX No. I.

Remarks on Bark-peeling. By Thomas Knowlton, *Esq. of Edensor, near Bakewell, Derbyshire.*

It is almost universally allowed that it is much better for oak timber, that it should be cut down in the winter months; and that seems to be the principal reason for taking the bark off standing, that the trees may remain until the proper felling season. It can only be to indulge the indolence of the bark-peelers that the trees are suffered to be felled in May. It seems, by the observations of Mr. S. Pepys, in the Phil. Trans. Vol. xvii. p. 455, that it was the practice to peel standing formerly for ship timber, in other parts of England besides Yorkshire and Derbyshire, if it is not practised at this day.

The Scots mode of decortication is so very defective, there is no wonder that the bark fetches so inferior a price in the market. It is even worse than the Irish mode. The latter is only to beat what will not come off without, in the latter summer months, after the sap has ceased to run, as the tanners will not in that country give so high a price for that which they call box bark (or boxed bark), as for that which has not been beaten or boxed, for this plain and obvious reason: wherever the club or mallet has dealt the blow, that part of the bark being bruised, will spend, as the tanners technically call it, or lose its tanning by the first shower of rain, which will inevitably wash it out. Of course the bark is exhausted, and can yield but a weak tanning liquor in the vats.

The Scots mode of setting up and saving the bark after it is peeled, is also very bad. When once it has been set up, if properly done, which should be with the rough side outwards, it should never be turned; as exposing the inside to the weather, has likewise

the effect of washing out the tanning. It should neither be set so thick and close as to produce mouldiness, which experience and observation will soon enable the overlooker to judge of.

In this country, as great a part of the circumference of the branches and stem is the aim of the peelers to take off at once as possible, and not long pieces or stripes.

The manner of setting it up is, to select a fine slender pole for a horse, which is fixed upon forks driven in the ground at a proper height to suit the length of the pieces of bark, as near to the tree to be peeled as possible. The smallest pieces of the bark are first set up against this pole or horse, then the larger pieces on the outside of them to protect the smaller pieces from the weather, all with the rough or external part outwards, which prevents its receiving damage from the rains. About the third of June it will be fit to take up by the tanners, and lead home. On the fourth of June this was done here this year, although it has been an uncommonly wet season.

Women and children are employed in gathering and setting up, but never in the decortication. Stout and active men only are fit to do that work standing; and even where the trees are felled first, women are scarcely able to take a part in the operation.

With regard to expedition, we hold the opinion that a man can peel more standing than he can when the trees are down, as he can begin at the top, and work round the tree without interruption, the bark all falling before him out of his way; the women and children gathering and setting it up as fast as it falls. Whereas, when the tree is felled, the peelers must raise it up on a horse, or fork, in order to get round it to take off the bark on the under side, which loses a great deal of time, and in large timber requires many men to horse a tree, or, if too large to be horsed, to roll it over; and when once accustomed to peel standing, the men prefer it, because they can do it with more ease and expedition, and make better wages, as they are paid according to the quantity decorticated.

It is not uncommon for the tanners to buy the bark on the trees, and to take the care and expence of peeling and saving wholly on themselves.

It cannot escape observation, that by Mr. Nicol's account of the Highland mode, the trees must all be very small, and scarcely fit to make a common inclosure rail, or the carriers could not carry them to the place where he describes the barkers to be seated. His account is either partial, or there are no large trees in the Highlands. Such small trees as men can, when cut down, bundle up, and carry on their shoulders, could not be peeled standing, as they would not bear a man in their tops; but they might, (presuming they are too small to be peeled standing) with much greater facility be peeled where they are felled, by active men; and even women might take a part with such light trees, with proper tools, and the bark be set up by women and children at the place, than by carrying the trees to any, even a short distance. It is surely better to have only the bark to remove, than to carry the trees with the bark on them. The hide of a bull is easier to carry than the bull with his hide on his back. This mode, where the trees are small, and a better system of saving the bark, might, I think, be introduced into the Highlands without a great deal of difficulty. A good peeler with the larger

peeling iron, one of which I have sent to Sir John Sinclair, with a complete set of Derbyshire peeling tools, should precede the feller, and take off eighteen inches or two feet of the bark near the bottom of such trees as will run, that none may be wasted by the axe, and the feller should follow him and cut down those trees so prepared for him, and no other. This will have two good effects; it will direct the feller what trees to cut down, and prevent the waste of at least six inches of the bark, which is best both in quality and quantity at the bottom of the trunk. The peeler will of course have left the stickers, or those that will not run, after trying them with his iron, until another day, when perhaps they may run; and he should try them frequently until the end of the sap season. In this manner I conceive they may proceed, and the necessity for beating or boxing be avoided. Such stickers as will not run during the season should be left until the year following, when most of them will run, and the remainder may then be cut down and boxed, and the wood be cleared and fenced up. The stickers are always managed in this way in this country, and the inveterate left until the year following.

Without a precaution of the kind recommended above, of a peeler preceding the feller, the latter will indiscriminately cut down all before him, and six inches of the best bark be destroyed by his axe, as well as a necessity for beating be the consequence.

The peeler must have a small axe with him, and nick the bark through with it round the circumference of the tree, at the lowest part where it is to be felled, and again as high up as he means to take it off. The bark of small trees will be much sooner ready to house than the thick bark of large trees.

APPENDIX, No. II.

On Felling the Tops of Oak Pollards.

The following useful Hints, regarding the Felling of Oak Pollards, extracted from the Agricultural Magazine, are not unconnected with this Subject, and merit Attention.

It must be unquestionably acknowledged, that almost every practice in husbandry which is detrimental to the individual who persists in it, is proportionally so to the community at large, and of course demands the exertions of every well wisher to the public weal to repress it, by endeavouring to convince those who, from prejudice or inattention, continue in errors, which plain reason is sufficient to correct. An omission or oversight of this nature, I have the mortification to annually witness in the felling of the tops of oak pollards in the winter season; there certainly is no part of the county of Norfolk but furnishes examples of the contrary, yet strange it is, that many are too blind to their own interest, to profit by the hint. Why not defer that operation till the spring, and take two crops instead of one? No doubt the *bark* on a well hung pollard top, is of infinitely more value than the wood, which is commonly of no other use but to burn, and is bound

into faggots for that purpose; yet how repeatedly do we see this totally disregarded, from an idea, perhaps, that it would not defray the expense of striping. I have, generally, a small quantity of wood of this description to fell every year, therefore can speak from experience: and the following short statement, I hope, will convince those who are not already aware of the loss they sustain, by felling oak pollard top wood in the winter season. The largest quantity I ever topped at one time, was in the spring of the year 1808, and which amounted to seven hundred faggots, being the produce of seventy-five pollards, part of which I sold, and part retained for my own use; but calculating the whole at the price per hundred (thirty-six shillings,) which part was sold at, the value whereof is no more than twelve pounds twelve shillings; whereas the bark that was taken therefrom, together with that of seventeen old pollard bodies of very inferior quality, I sold in the lump, to deliver free of expense to the purchaser at the distance of about eight miles, for the full sum of thirty-five pounds! Thus supposing the bark taken from the said seventeen pollard bodies, to be worth three guineas, (which I have no doubt is really beyond the value,) and supposing also that four guineas are allowed for a day's work of six horses and two carts with their attendants to deliver the same at the tan-yard, there then remain twenty-five pounds, eleven shillings; which after deducting the expense of striping, (seven ponnds, ten shillings, i. e. two shillings per top for seventy-five tops,) I have clear profit over and above what the whole would have produced, had it been felled in the winter, *eighteen pounds one shilling!!* This certainly is no inconsiderable sum, yet be it remembered, that the charges for labour have in the latter statement been deducted, and not in the former; I mean for felling and tying the topwood, (four shillings per hundred faggots,) so that there still remains a deduction of twenty-eight shillings to be made on the sum total of the value, before we compare the net profits of each respectively, and which will be found as follow:—

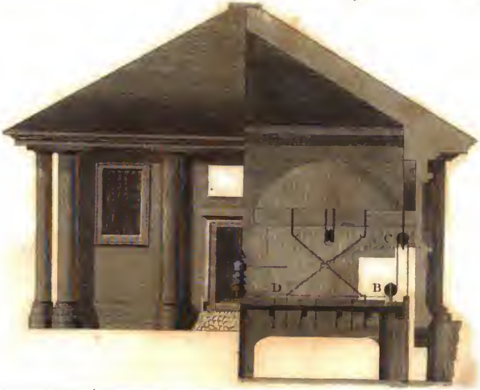
	£.	s.	d.
Seven hundred faggots of wood, after deducting the charges for labour,	11	4	0
The bark arising from the above, after the same deductions, -	18	1	0

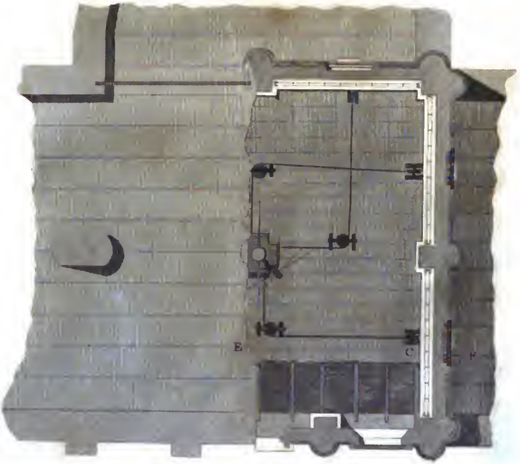
It now only remains necessary to add, that the above statement is correct to the best of my knowledge; and I think hereafter no one (in possession of the information,) will be guilty of the like egregious blunder of which I complain. The covenants in leases, confining the tenant to do a certain quantity of ditching every year, " he being allowed the top wood, save such pieces as are useful for repair," is rather ambiguous, and probably infer that the wood is to be taken at the time, or immediately before the ditching is performed, which is of course in the winter; and were the tenant to defer felling till the spring, it might be objected to, under an idea that it is injurious to lop trees after the sap is up; but this I am able to contradict, as those which I have so treated are now producing as vigorous shoots as others whose tops were felled in the winter.

Lingwood, Norfolk, 1811.

Plate 1

Elevation & Section of the BALCONERA or Gate Building.





No. XXVII.

The following Communication on Irrigation, as practised in Piedmont *and* Lombardy, *was given to* Arthur Young, *Esq. many years ago, by* Don Roderigo de Souza Coutinho, *the Portugueze Minister at the Court of* Turin. *Mr.* Young *presented it to the Board, as he received it, in the Italian language. The Board, anxious to extend so beneficial a practice, have had it translated, in the hope that some useful information may be obtained, so as to carry Irrigation to a greater perfection, and more general use, than it has hitherto attained in this Country.*

HAVING been appointed by the Minister Plenipotentiary to form a plan of irrigation, which might embrace our best practical rules both in leading and distributing water, I could scarcely express the satisfaction I felt, considering this commission so much connected with public utility; but when informed that this plan was intended for H. R. H. the Most Serene Prince of the Brazils, I was embarrassed and confused, from being under the necessity of acknowledging my inability to satisfy the great views of that prince, who, having so much at heart the prosperity of his subjects, would not fail to examine the work with that mathematical exactitude and accuracy which is the happy result of his long studies, so ably directed by an eminent mathematician, of whom I beg the favour to correct my errors, and excuse them to that enlightened prince. Having thus premised with my necessary apology, I proceed to state:

The Piedmontese, and the Milanese, are the two linear measures considered in this plan, although it be entirely drawn, and for the most part calculated, with the Piedmontese* only.

The measure used in Piedmont is commonly called *trabucco*, which is divided

* The Parisian being the term of comparison between these two measures, I have taken their relation to this third measure according to the practice of engineers; yet in the admeasurement for the distribution of water, I have endeavoured to avail myself of the nearest relation to the Piedmontese measure; whereas for the Milanese I follow those which are now practised in the provinces of the Dutchy of Milan, being under the dominion of my sovereign.

According to Bowles's table, the Paris foot is to the English as 12.788 to 12, or is a fraction more than 12 inches and three quarters; according to Adams, in his Graphical Essays, (p. 512) 12,792.

into six feet called *eliprandi*, each *eliprando* foot being composed of twelve inches, the inch of twelve lines, and the line of twelve points.

The Milanese *trabucco* is composed of twelve feet, or as they call *braccia*, arm's length; each foot, or arm's length, being of twelve inches, the inch of twelve lines, and the line of twelve points; such a measure is also used in the Novarese, Lumellina, and Vigevanasco Milanese provinces, which are under the happy government of my sovereign.

The Piedmontese* *eliprando* foot, according to practical rules, being compared to the Parisian measure, will be one foot, seven inches, two lines, and one fifth of the line; the Milanese foot, or arm's length, making one Parisian foot, nine inches, and six lines, the Piedmontese *trabucco* therefore would be nine Parisian feet, seven inches, one line, and one fifth of the line; while the Milanese† *trabucco* is twenty-one Parisian feet, and six inches. These reductions, although allowed by the engineers, are not the most exact.‡ Hence they proceed from these linear to the superficial measures in the following manner:.

They suppose an equilateral square of one foot to be divided into twelve inches, or twelve rectangles of one foot long, and one inch broad, each of these rectangles, called *inch of the square foot*, being divided into twelve lines, or rectangles, one foot long, and one line broad, and each of these rectangles called *line of the square foot*, or *line of the foot*, to be divided into twelve other rectangles of one foot long, and one point broad, each of these being called *point of the square foot*. They likewise conceive the Piedmontese square *trabucco* to be divided into six feet of the *trabucco*, or six rectangles, each being one *trabucco* long, and one *eliprando* foot broad. The Milanese square *trabucco* containing twelve rectangles, each one trabucco long, and one foot, or arm's length broad, and so on with the inch, and the line of the square *trabucco*. The Piedmontese square *trabucco* should, in fact, contain thirty-six squares, each being one *eliprando* foot on each side, while the Milanese *trabucco* is composed of one hundred and forty-four squares, each being

			f.	in.	
* The Piedmontese or Turinese	eliprando foot is equal to		1 :	8,17	English.
	trabucco	- -	10 :	1,02	
† The Milanese - -	braccio is equal to	-	1 :	11,5	
	trabucco	- -	23 :	6	

‡ The Milanese braccio is equal to 1 f. : 10,045 in. Parisian measure.

of one foot, or arm's length on each side. The square of one foot, or arm's length, is called by the Milanese *quadretto*, while the *trabucco* is called *zuccata*. The rule of multiplication by *length* and *breadth*, so called by the engineers, is founded upon the above mentioned principles. For instance, the Milanese linear foot being equal in Parisian measure to 1 foot, 9 inches, 6 lines, the square foot, or Milanese *quadretto* will be equal to $1:9:6^2 = 1:9:6 \times 1:9:6$—thus

		f.	in.	lines.	pts.
Multiplicand	-	1	9	6	
Multiplier	-	1	9	6	
Product: For one foot	-	1	9	6	
nine inches	-	1	4	1	6
six lines	-			10	9
Sum		3	2	6	3

which being reduced to square inches and decimals, makes the Milanese *quadretto*, or square foot, equal to 462,25 square inches Parisian measure.

I shall give no opinion here of the facility or conveniency of this operation and division of parts*, adopted long since by our engineers; perhaps it has its value. The same division of parts intended for the superficies, may be easily applied for the measurement of solids, that is to say, for the cubes of a *trabucco*, of a foot, and its twelve parts.

The admeasurement of land in Piedmont is calculated by *giornate*, or day's work, by *tavole*, or planks, by feet of the plank, inch of the plank, &c. &c.; and in the Milanese by superficial perches, by *tavole*, or planks, or square *zuccate*, by *quadretti*, or square feet, by inches of the square foot, &c. &c. In Piedmont a square, whose side is equal to twenty *trabucchi*, compose one *giornata*, or day's work, which is divided into one hundred *tavole*, or planks, therefore the plank of land will be a square whose side is equal to two *trabucchi*, the square *trabucco* will contain thirty-six *eliprando* square feet, admitting that one *eliprando* foot is equal to one Parisian foot, seven inches, two lines, and one fifth of the line, the square *trabucco* will be Parisian square feet $92:0:1\frac{11}{25}$ of a square line.

* This example, shewing the method of writing down the quantities, being the same adopted for the linear, as well as for the measurement of solids, we shall find no difficulty to understand the meaning of the foot, or of the *trabucco* and its parts.

The *tavola*, or plank, containing 368 Parisian square feet, 0 square inches and $\frac{4}{100}$ of a square line, the *giornata*, day's work, or one hundred *tavole*, or planks, will be equal to 368,000 Parisian square feet, 0 square inches, and 4 square lines. In the above-mentioned Milanese provinces the square *trabucco*, or square *zuccata*, forming the *tavola*, or plank, will be equal to 462 Parisian square feet, and 36 square inches; while the perch, being composed of twenty-four of these planks, will contain 11094 Parisian square feet.

The measurement of excavations, as well as rising grounds, both in the Piedmontese and Milanese territories, is formed by cubes of a trabucco, and its parts, conceived in the same manner as the linear and superficial measurements, such a method being also observed in the measurement of walls, and every other sort of buildings.

In Piedmont water is measured by the *eliprando* foot, and in the Milanese provinces by the foot, or *braccio*, arm's length. The basis for both countries is called inch, although they differ, being differently conceived, as will be seen hereafter Every distribution of water in Piedmont is distinguished by *ruota*, containing twelve inches, or parts of twelve points each; while in the Milanese it is measured by inches, twelve of these forming together the measure called *rodiggio*, as the twelfth part of the inch forms the *point of water*. I think it necessary to take here a cursory view of the fundamental principles of hydrometry, upon which all sound practice for the measurement of the divisions of water is founded; I say cursory only, since, upon this subject, the profound and extensive information of that enlightened prince, to whom I have the honour to address this work, is sufficiently acknowledged.

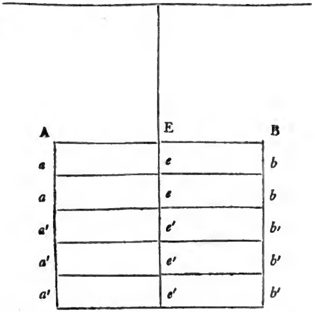
There are two elements or principles by which the division or distribution of water, passing either through an orifice, or running through any section whatever of a river is calculated, that is to say, the area of the orifice, or section, and the velocity with which the water runs; the measurement of the area depending on geometry, while it is by hydraulics that we are informed that water, while running out, does not fill the whole opening or section; but being reduced in a certain proportion, which experience has taught to be as eighteen to eleven,* and that such diminution or restriction of the area of the water extends to the distance of

* By more modern experiments, as 18 to 11½, or 16 to 10.

about a semidiameter of the orifice, it is evident that the area given by the geometrical measure must be always diminished according to the abovementioned proportion.

It has been lately demonstrated, by the most accurate experiments, that the velocities of fluids issuing from openings, or passing through a free section of a river, are in a ratio subduplicate of the heights pressing down upon them. A parabola is described by their velocity, the perimeter of which will be 60,36225 Parisian feet, or Parisian inches 724,317 according to our standard. If I were not wandering from my subject, I should here mention how these experiments have been proved by Bossut and Frisi, both eminent mathematicians, by my father, and repeated by me, assisted by all the advantages afforded by the beneficence of our sovereign for all public instruction. Thus multiplying the area, diminished as above, by the velocity of the water issuing from an orifice, or running through a section of a river,* we shall have in a given time the product of the quantity of water; but if we consider water that runs through an opening to be divided into so many strata or beds, parallel to each other, we shall conceive that each stratum or bed will have a different velocity, because the height is different from which each bed is urged forward, so that the lower will have a greater velocity than the upper parts of the opening; therefore it will be necessary to find out from the whole height, from which the water falls generally, a point from which a velocity may be produced, by which, supposing all the strata to come together, they would send forth a quantity of water equal to what it would be if all the strata issued from that point. Thus A, B, b', a', being a perforation through which the running water is to be divided in so many parallel beds or particles, A E B $b\ e\ a$, $a'\ b'\ e$, $a'\ b'\ a'$, it is evident that F E being the height pressing down the first bed A E B, F e will be the height pressing down the second bed $b\ e\ a$, and F e'' the height pressing down the last $a'\ b'\ e$, $a'\ b'\ e$.

* We understand a section of a river to be a vertical plane; having its height equal to the fall of the water running; and its breadth, the distance from one bank to the other taken perpendicularly across.



We should next find what height is capable of producing such a velocity upon the strata taking collectively as would discharge as much water as by the several strata coming forth with their proportionate velocities from the respective heights pressing down upon them. This height thus found will be called the equalized *height*, or medium, the point F e'', which will indicate it, being called the *centre* of velocity, and that velocity which is corresponding thereto shall be named the *medium* of velocity. The height F E, described by the upper lip A B of the orifice at the point E, is sometimes called *discharge of water*, but oftener a *water-fall*; and if the orifice should be without water-fall, then the area or space is called the outlet, that is to say, when the lip A B coincides with the level of the water running through the orifice.

Taking this for granted, let us suppose, in the first place, a square orifice, or a square section of a river without water-fall, a being the side of the orifice, Q the distribution, P the perimeter of comparison, and Z the height capable of producing the velocity with which a stratum of fluid issues from the orifice; so that $P^{\frac{1}{2}} Z^{\frac{1}{2}}$ denotes the velocity. $a\,dz\,P^{\frac{1}{2}}\,Z^{\frac{1}{2}}$ being the flowing of the distribution, whose integral parts do not flow constantly with an equal cousre; so that the distribution will cease, when $Z = o$ will be $\frac{2}{3}\,a\,Z^{\frac{3}{2}}\,P^{\frac{1}{2}}$; and when $Z = a$, $Q = \frac{3}{2}, a^2$ $\sqrt{}\,a\,P$ will be the quantity in one second of a minute. A being the propor-

tionate height, it will become $Q = a^2 \sqrt{A\ P}$, and $\frac{2}{3} \sqrt{a} = \sqrt{A}$, therefore if $a = 1$, $\frac{4}{9} = A = 0,\ 44444$, that is to say, the velocity of water running through orifices, or sections of rivers without water-fall, is owing to the proportionate height being equal to $\frac{4}{9}$ of the height of the same running-water; this velocity may be likewise ascertained for any orifice or section, of whatsoever form it may be.

Now if a determined quantity of water from an orifice should be required, it must be observed, that the areas, or superficies of outlets, are contracted in the proportion of eighteen to eleven; therefore the set form for measuring the quantity of water running through openings so placed will be $Q = \frac{11}{18} a^2 \sqrt{A\ P}$, where a^2 can represent the area of any opening or section whatever. The level, the *Pitbometrical* tube,* or some other instrument of hydrometry, the nature, and the position itself will shew to us those openings, or sections, where the proportionate velocity might be considered at $\frac{4}{9}$ of the height of the same running water.

Let us now apply our calculation to both gates of the *Balconera*, (Plate I.) or building for the conveyance of water, being the place where the measurement is to be taken, (supposing the water, in its course to the said building, passes over a steep ground, and is conveyed obliquely into the principal canal, so that the velocity of the river at the said building, or gates, is no longer perceptible) the breadth of both gates being measured together, and put with their bottom on the same level, will be of three Piedmontese *trabucchi*, or eighteen *eliprando* feet; so that in the time of dryness, the height of the water passing through these gates will be one foot and six inches. The dimensions being all reduced to inches, the breadth of both gates is two hundred sixteen inches, and their height will be eighteen inches; therefore the area being 3888 inches $= a^2$; and diminishing it in proportion of eleven to eighteen will be $\frac{3888}{18} \times 11 = 2376 = \frac{11}{18} a^2$; the perimeter P, according to our standard in Piedmontese inches, would be of 458,085: the proportionate height being $A = \frac{4}{9} a = \frac{18}{9} \times 4 = 8$ inches, the velocity $\sqrt{A\ P}$ will be of 60,536 inches for every second of a minute. The substitutions in the set form being made $Q = \frac{11}{18} a^2 \sqrt{A\ P}$, it will be found $Q = 2376 \times 60{,}536) =$

* "Il tubo Pito corretto;" literally the correct (*pythometrical perhaps*) tube, here seems to be a technical or local term, formed by its introduction for the purpose of admeasurement.

143833,536 cubic inches; now the cubic foot containing 1728 inches, therefore dividing Q by 1728, the determined quantity of water will be 83,2378 cubic feet.

This method of considering the orifices, or as they are called, the mouth-pieces without water-fall, is the fundamental principle obtained by the unity of our admeasurement of water in Piedmont. The architects suppose, in the bank of a vast reservoir constantly filled with water to the same height, a hole, or square opening of one *eliprando* foot each way, cut in a thin partition wall, so placed that its upper side is on a level with the horizontal surface of the stagnant water in the reservoir; through this opening the water will run with the least degree of natural velocity; correspondent to a height of one eliprando foot of high or top water, that is, because there being no water-fall, its medium of velocity will be found precisely at $\frac{4}{9}$ of the same foot, or five inches and four points below the surface of the water. But, as in practice engineers are not very scrupulous in their reckonings, so taking the perimeter of 38 *eliprando* feet only, they determine the velocity belonging to the same height to be 4 feet 1 inch and 4 lines every second of a minute; if the area of the opening were multiplied by a square foot, the result would be 4, $\frac{1}{144}$, $\frac{4}{1728}$ cubic feet for every second of a minute; here however the contraction of the channel not being considered, the quantity discharged is called distribution in full mouth, while the cubic feet 4, 1, 4, are called *ruota grande*, or large measure, containing 7104 cubic inches, so that the inch of our water, or its twelfth part, will be 592 cubic inches for every second of a minute; but if the contraction should be considered, the quantity of water must be then diminished in proportion, and instead of 4, 1, 4, it would be 2, $\frac{6}{144}$, $\frac{3}{1728}$ cubic feet, or 2, 6, 3 (called little *ruota*, or measure), and equal to 4356 cubic inches for every second of a minute, the twelfth part, or the inch of water being 363 cubic inches for every second of a minute.

In the preceding paragraph we have described the method of determining the proportionate height which produces the medium of velocity through a square opening without water-fall; now if this opening, instead of being put to the level of the water, were placed at some depth below the level, calling such a distance 6, it is evident that the change of circumstances would change the method, which may be found thus: admitting a to be the height, d the side of the opening, z the height of a bed, or particle of fluid, so that $6+z$ being the whole height pressing down the water to its issue; $P^{\frac{1}{2}}(6+z)^{\frac{1}{2}}$ will be the velocity, and $a\,dz.\,(6+z)^{\frac{1}{2}}$ will

be the flowing of the quantity; therefore the whole distribution would be $\frac{2}{3}\ a\ P^{\frac{1}{2}}\ (\overline{6+a}^{\frac{3}{2}}-6^{\frac{3}{2}})$, and calling A the height that would bring forth the medium of velocity, will be $a^2\ P^{\frac{1}{2}}\ A^{\frac{1}{2}}=\frac{2}{3}\ a.\ P^{\frac{1}{2}}\ (\overline{6+a}^{\frac{3}{2}}-6^{\frac{3}{2}})$ therefore $A=\frac{4}{9a^2}\ (\overline{6+a}^{\frac{3}{2}}-6^{\frac{3}{2}})^2$, with which we shall find out what was sought for; and if curiosity should carry us further, we might in the same manner ascertain the center, whatever might be the change of the water-fall.

A being fixed, the set form for the distributions with water-fall would be $Q=\frac{11}{18}.\ a^2\ \frac{2}{3a}.\ (\overline{6+a}^{\frac{3}{2}}-6^{\frac{3}{2}}).\ P^{\frac{1}{2}}=\frac{11}{18}\ a^2\ \frac{2}{3a}.(\overline{6+a}^{\frac{3}{2}}-6^{\frac{3}{2}});\ P^{\frac{1}{2}}=\frac{11}{18}\ a^2\ \frac{2}{3a}\ (\overline{6+a}\sqrt{6+a}-6\sqrt{6}).\ P^{\frac{1}{2}}$.

The same method for A may be adopted for other rectangular orifices; therefore if we should call P^2 the area non contracted of a rectangular orifice, whose height being a, $\frac{11}{18}P^2$ will be the contracted area, and $Q=\frac{11}{18}\ P^2\ \frac{2}{3a}.\ (\overline{6+a}.\sqrt{6+a}-6\sqrt{6})\ P.^{\frac{1}{2}}$

Let us now apply it to the first derivation or diversion placed on the right bank of the principal canal, having a mouth piece two feet broad and one foot high, with six inches of water fall. Therefore $P^2=288$ square inches, and $\frac{11}{18}\ P^2=176$ square inches, where $a=12$ inches; therefore $6+a=18$, and $\frac{2}{3a}=\frac{2}{36}=18$; $\overline{6+a}.\times\sqrt{\overline{6+a}}-6\times\sqrt{6}=18\times\sqrt{18}-6\times\sqrt{6}=\sqrt{A}=76{,}3675-14{,}6969=61{,}6706$; $18\div61{,}6706=3{,}42614\times18=61{,}6706.\ P^{\frac{1}{2}}=733288.=\sqrt{A}\,P$; finally $Q=\frac{11}{18}P^2\times\sqrt{A}\,P=12905{,}869$ cubic inches, or 7 cubic feet, and 810 cubic inches for every second of a minute.

The rule of measurement in the Milanese, is founded upon a calculation, that the orifices are placed below the level of the water, or as they say with water fall. The Milanese inch of water* is contained in a rectangular area, three inches of the *braccio*, arm's length, broad, and four inches high, with two other inches of water-fall; that is to say, the water must fill the whole area, and moreover rise by two inches above it. This area is called the mouth of the inch, because the square arm's length, called *quadretto*, or square, is divided by the Milanese into inches,

* This is not to be confounded with the square inch, but considered as $\frac{1}{12}$ part of a square foot, equal also to 12 inches long and 1 inch broad.

and points, as has been already mentioned; therefore one inch of arm's length, called *quadretto*, is contained in a rectangular surface of one *quadretto* long, and one inch broad, that is to say, of twelve square inches, as many as may be contained in the area of the mouth piece of an inch. It must be however observed, that the constant water-fall of two inches is so regulated, for whatever rising or swelling of the water of a river, or acqueduct may happen, that by the help of a little machine the land-owners may know with a precision, almost certain, the quantity of the water.

Plate II. We shall now describe this machine as detailed by the Milanese engineer: according to the annexed drawing.

In a line with the banks there are two rectangular stone prisms A T, vertically placed, and distant from each other in proportion to the breadth of the mouth-piece, or outlet; there is betwixt them a gate, or wooden cataract, called *paradora*, to be lifted up, and let down by its casements worked in the same prisms; at whose bottom, in T, there being a stone floor or pavement no lower than the bottom of the principal canal. Next, and close to it, there is a canal called the *covered trumpet, or chalice*, being formed with banks O P in masonry, ten *braccia*, or arm's length, parallel, and distant from the opening M M the space M O of five inches, and as high as it is wanted. There is upon these banks a vault E which extends along the whole canal; from the floor T the vault is continued in an horizontal plain T H as far as the end of the banks; and at H there is a rising ground in masonry in form of a step H G, eight inches high. On the point G is the mouth-piece in a single stone, with its area of the height G F of four inches, and of the breadth Q Q = M M according to the quantity of water to be drawn; and this area, called the frame, must be hooped with iron. The ground floor of this covered channel being all in masonry, is formed upon the horizontal plain T H, or rather ascending upon the line T G without forming the step G H. This canal is crossed behind the gate by a piece of stone N twelve inches high, on the threshold T, that is to say, at the level of the upper part F of the frame, supporting a wall, which closes the area or space of the vault, leaving, however, between the area and the gate, some little space B quite open. Under the vault there is, however, a ceiling, C, D, being formed exactly horizontal, either with stone, tiles, or with boards, well joined, of 14 inches, to the height of the threshold, so that the spaces F D, N C may be of two inches;

The Machine for regulating the Distribution of Water.

Drawn from the description by Peter Potter

this ceiling being called the *dead ceiling*. Finally, there is also upon the frame another wall closing the whole vacuum of the vault.

Beyond this canal, and besides the frame, there is another canal, called the *uncovered channel*, the whole being built in masonry, and nine braccia, or arms length long, having its banks R S vertically raised, and at R distant two inches from the area of the frame, and diverging three inches as far as S; its bottom beginning at I, by one inch below the lower part G of the frame, continues with a declivity of another inch as far as its limit L, after which the water comes in at the disposal of the proprietors.

After this description of the machine, it will be easily conceived how it acts; for whereas the gate being lifted up, the water coming in with a velocity proportionate to the height of the water of the principal canal, encounters an obstacle of a rise of eight inches below the frame, and then the water becoming dead calm, and thus restrained, must rise in order to run out of the frame, so as to fill the whole canal, called the *covered channel*, up to the dead ceiling, where being no empty space, or passage for external air, there will be no motion in the water, which being suffocated, has no other space to rise again but at B. Therefore it is evident that the water must rise 14 inches over the threshold, and in the space *B*, so that a mouth piece, or outlet, may have the quantity of water required, that is to say, the whole area of the frame may be filled, besides two inches of water-fall, because eight inches of rise below the frame, four inches the height of the frame, and two inches of water-fall, make fourteen inches all together.

The method of making use of such a construction, and by its help how to give to the mouth-piece, or outlet, its only ratio of water, whatever may be the rise of water in the principal canal, is now very easily understood. Therefore if the water in the canal be only fourteen inches deep, the gate must be lifted up from the threshold of the mouth-piece, and left quite open; but if the water be deeper, the gate must be lowered as much, as at *B* behind it the water be only fourteen inches deep; and if the water of the canal increases or decreases again, the gate should be lowered, or lifted, until we have at *B* the fourteen inches required. The whole of this operation amounts to find out, practically, the various increase and decrease of the water in the principal canal, the height of the area of a given breadth under the gate at the mouth piece or Paradora, through which the required quantity of water is to pass: but if it should happen, that even by lifting

up the whole gate, the water at *B* should not be found fourteen inches deep, as would happen if the canal had not water fourteen inches high, the mischance would then proceed from nature, and be without remedy.*

Besides this method of admeasurement by the Piedmontese, as well as by the Milanese, there are, in many provinces, certain peculiar rules in distributing water, and this especially for the convenience of the peasants: that most generally adopted is the division by hours. A number of owners having the privilege of irrigating their fields with water constantly running from a reservoir called *Bealera*, or from a little canal, where Titius is allowed water for three hours, Cajus for six, Sempronius for ten, &c. &c. it is thus conceived: The body of this reservoir containing a sufficient quantity of water to irrigate all those fields, this water is wholly at the disposal of that owner, having a proportionate claim, for three, six, ten hours; such a method is very convenient for the owners, and in case of dispute the dial will settle it. It must however be observed, that such a method is only adopted in small reservoirs, or irrigating canals, and in private diversions from the principal canal; as every body can easily conceive that a great canal, or reservoir, can never be for many hours entirely at the disposal of any single owner. The irrigations being adapted to the quality and situation of the soil; the time betwixt one and the other is never less than six, nor more than fifteen days, so that the same flow of water may suffice to irrigate a certain quantity of land.

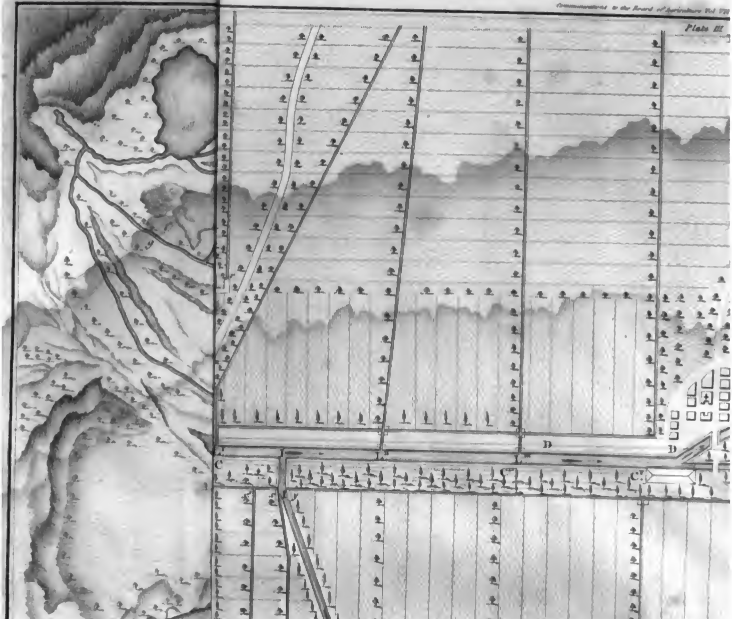
If any body should ask how much water would be necessary to irrigate a given quantity of land, the question could not be so easily determined, since the soil is different in proportion to the difference of the provinces, situations, &c. &c. Father De Regis has nevertheless observed, that about 67,044 cubic feet of incessant water running from the springs, will be sufficient to irrigate, in one day, forty-three and two thirds superficial Milanese perches† of sandy and uneven meadow.

Plate III. Let us now pursue the description of our plan, and suppose that a body of a river A A′ A″ A‴, and which lately was running betwixt mountains and hillocks, is flanked on the left side by steep mountains forming its banks, which on

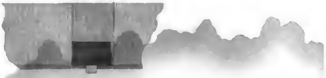
* Some of the engineers having no better method for the measurement of water, have often recourse to this little machine, while others, knowing their profession by practice, have no want of it, particularly so, since little imperfections may often occur owing to the knavery of the grantees, who are acquainted with this machine.

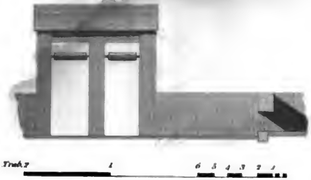
† Equal to 12 acres, 2 roods, 20 perches.

Plate III

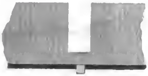


Diversion I.





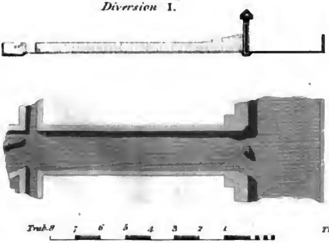
Diversion I.!

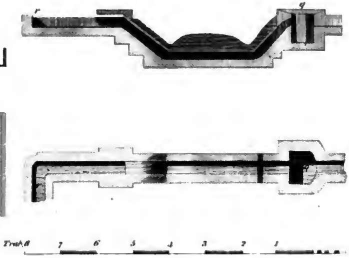


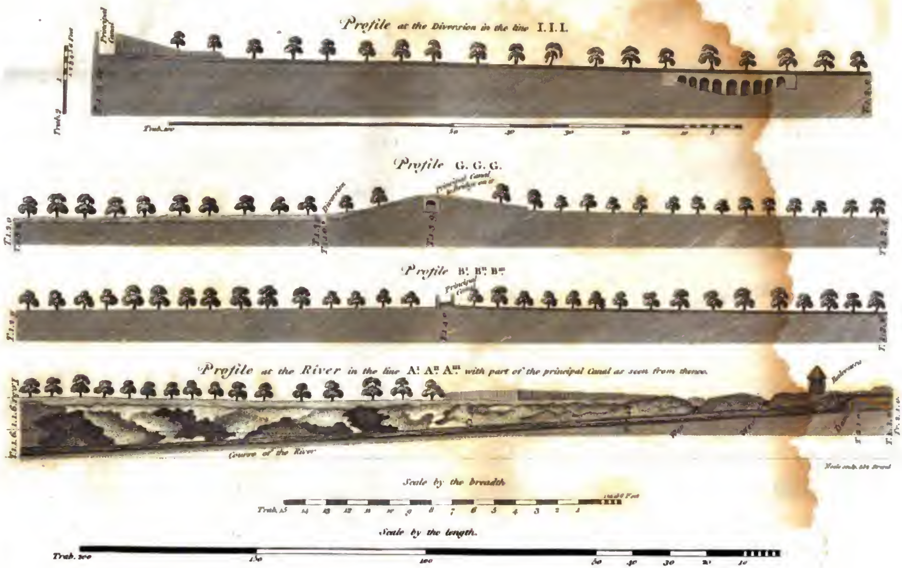
Diversion

I.II Diversion I.III

Diversion I.






Profile at the Diversion in the line I. I. I.
Principal Canal
Profile G. G. G.
Diversion
Principal Canal & Bridge on it
Profile B.I B.II B.III
Principal Canal
Profile at the River in the line A.I A.II A.III with part of the principal Canal as seen from thence.
Course of the River
Dam
Scale by the breadth
Trab. 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1
Scale by the length.
Trab. 200 150 100 50 40 30 20 10

that side are bounded by a hill, or little eminence with a lake on the top, as by the drawings. On the right side of the river there is also a solid bank, so high that it may restrain the most abundant streams, so that the adjacent fields to be watered may be preserved from inundation; the bed of the river being formed of solid matter, as large stones, and rocks spread over with gravel, &c. its banks being of the same solidity. Let the declivity of its bottom be almost uniformly five *eliprando* feet for every one hundred Piedmontese *trabucchi*, or for every six hundred *eliprando* feet measured along the winding channel of the river; its right bank having for its height five feet, and six inches measured from the bottom at A, and ending by that of about fifteen feet, as will be seen from the profile, Plate IV. marked A A' A'', &c. &c. And as when attentively ascending towards the source of a river, we observe in the first place, that the water running rapidly amidst declivities of mountains, carries indiscriminately away large and small stones, as well as mould, and gravel; in the second place, that these materials are gradually deposited in the bottom of the river, as follows; in their descent through the first branches of the stream, they are spread or heaped at bottom; the large and irregular stones being the first, the round and the smallest the next, then the large and small gravel, and finally, the pure mould and sand. By these just observations we may conceive, that our river, in the place which is marked by the plan, no longer carries down heavy masses of rock, (in which case the art would even suggest the mode how to make use of its water,) but rather lesser stones and pebbles, which are not so frequent and numerous, as in the inferior branches, where the bottom is almost regular in declivity, and encompassed besides, as it were, by the best banks; therefore all its preceding velocity proceeding from its first descent, and afterwards increased by its declivity, will force the water against any matter extraneous to it— so that there will be no danger of the bottom being clogged or raised, notwithstanding some obstacle drawn into the way to obstruct the free course of the river, by a small quantity of gravel, and much less of small sand, which will be carried down to the branches below. Add to this, that our river is no more than thirty, and no less than twenty-five *trabucchi* broad, and that its height in the narrowest places is no more than five feet in the time of its most extraordinary rising, and no less than three feet in time of excessive dryness. From all these circumstances, it may possibly be concluded, that our river must have an immense velocity; yet the thing need by no means be so, since it appears from observations, that such

rivers and torrents have in their first branches some excessive fallings, and that the velocity proceeding from these fallings is diminished and corrected, where the water runs within solid banks, and more so where it draws nearer to the flat grounds, becoming at last nearly nothing, where the river is flowing over levelled and quite open grounds, when the water has no other velocity but that which is owing to the declivity of the bottom of the river, and to the fall of its course; for this reason the quantity of materials deposited, and consequent mischief and destruction to the land become greater in the time of overflowing; but our river participates more of the open and levelled ground, preserving besides the advantages of those which run between mountains; but as it is not always the case that the soil of the channel of a river is composed of the same materials, the beating of the streams against the banks will in process of time cause some windings and curves, and thus the river having lost its rectilinear direction, takes its course over a larger space of ground. This work of nature will be easily understood by observing the topographical maps of some provinces, whose torrents and rivers are of a similar description. Hence we have observed,* that at the most narrow section A, the height of the water in cases of dryness, and overflowing, is no less than three feet in the former, and no more than five in the latter case. Here it would be needless to advert, that the height of the water is less in larger sections; and admitting two branches of the same river to be equal in breadth, but different in velocity, here the height will be greater, where the velocity is less, and vice versa; this being not only confirmed by experience, but demonstrated by a theorem, which is the ground work of hydrometry; that is to say, the sections of a river are in a mutual proportion to the middle velocity of the running water. Having thus observed the declivity of a river, from which the water is to be drawn, it follows by consequence, that it shall be crossed in the most convenient place by some dam, or wier, whose height must depend not only on the height of its banks, but on the declivity and height of the land, where the principal canal is to be formed. The construction of a dam is very necessary in our river having a strong velocity, and being crookedly wasted along on one side by

* It will be seen by the plan, that such a point was necessary to be chosen in order to irrigate as soon, and as much ground as possible; and that it might comprise all that which was wanted, without making a large bulk of the drawings, although such a precaution in the choice of a point like this, must always be the first aim of the projector of canals of irrigation.

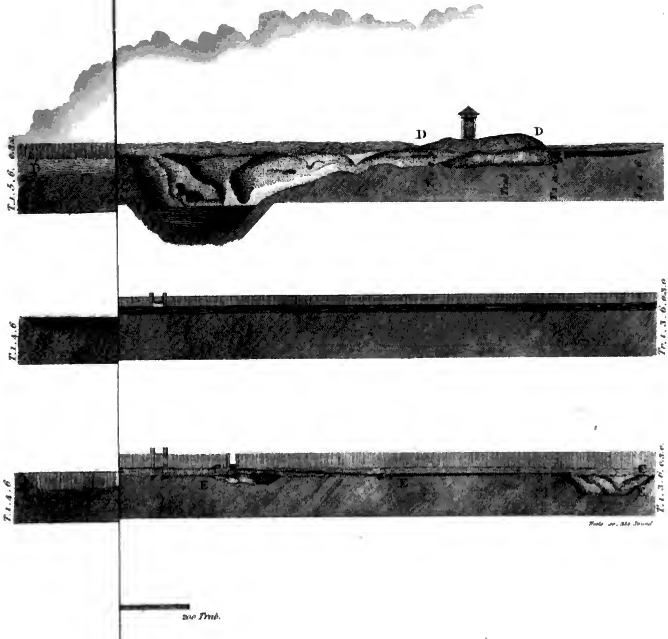
hills, and on the other by levelled ground, so that the dashing of the water from the left bank against the right, and the repercussion of the latter against the former, will cause the crookedness of its channel, therefore the river must be obliquely and partially crossed by the dam; but observe, that were the river entirely crossed, the settlings of the materials would form themselves into heaps before the dam, and the declivity of the ground, which is above, would be thus diminished, especially as the dyke must rise the water above the canal, so that every possible advantage might be obtained. Moreover concerning the exact position of the dyke, there is a query, which cannot be resolved by theory alone; that is to say, in what part of the river it is to be built, admitting all the circumstances to be equal, and whether the broadest, or the narrowest section is to be preferred for that purpose. In perusing our authors upon practice, as well as the collection of the authors of hydrometry from Florence, and Parma, and even from our country, we find both cases to be indistinctly admitted. The broadest sections, generally speaking, are the most adapted to give the easiest course to the great overflowing; but they require for the rest greater precautions; so that in the time of the river being lower, the canal of irrigation may not be deprived of the needful quantity of water, while on the contrary from the narrowest sections, this canal is more easily provided even in time of shallow water; yet more extensive breast-works and diversions are necessary to be formed in these sections, in order that the canal might not be overflowed in time of the greatest floods.

The place chosen is at A, as we may suppose, that above the point A there is no obstacle for placing a dam, which by a gentle flexure from the left bank is drawing near to the socket placed to the right, presenting thus a larger surface, than by a rectilinear form; therefore if the dyke is well built, the water more easily will take its course towards the mouth of the canal. In order however to avoid every mischance, which may be occasioned by the overflowing in the canal, and its mouth, there will be left before the dyke an opening of about two *trabucchi*, at the distance of twenty *trabucchi* measured from the right bank along the dyke, which opening may be easily closed up in time of low water.

Nor could such a place be more adapted for the mouth of the canal, where the bank of the river is five feet and six inches high, which being especially formed by an elevation of mould, and gravel, in length more than fifty *trabucchi*, measured from east to west, and in height about six feet above the bottom of the river at A,

which elevation, gently bending towards the south, is surrounded by the neighbouring land, which proceeding towards the west, is three feet high above the bottom of the river; therefore the mouth, and part of the canal may be excavated into that rise. But yet this is not sufficient to determine, within a small matter, the height of our dam. I said within a small matter, because geometrical precision is but very little regarded in these practical things; and thus the position and direction of the canal could not be exactly pointed out, in order to obtain the greatest advantage in watering as much land as possible. Yet it is absolutely necessary to determine the highest point of the land, with respect to that at A of the bottom of the river, and which point of land we suppose to be found at B, by the levellings marked in the plan, along the lines C C' C'' C''' C'v, &c. and D D' D'' D''', and mentioned in the respective profiles, see Plates III. IV. and V. It must be however observed, that these profiles are formed, as it were, in so many cuttings of the plan; that is to say, the canal of irrigation, as well as the position of the land towards it, and that of the river, are placed in the profiles, as they would be seen geometrically, or rather at an infinite distance: thus the profiles C C' C'', &c. &c. E E' E'', &c. &c. and D D' D'', and F F' F'', &c. &c. naturally come together, and distant enough from the letters corresponding with those of the plan. Moreover the dotted parts of the profiles indicate the tract of land which is bending from the canal of irrigation to the end of the levelled ground, and from the first diversion or opening marked B, to the bank of the river. The scale for the lengths in the profiles, although exact in the numerical quantity, yet is smaller than that of the heights; this being always practised in order to avoid that bulkiness in drawings, which would be inconvenient if the lengths were placed in the scale of the heights; on the other hand, the heights would be imperceptible, if placed according to the scale of the lengths.

Let us now make a short description of the land, and its declivity. After the rising ground as a bank to the river, and especially where the water is to be drawn by the dam towards C C' C'', and that is to say, towards the west, the land at C'' is placed along C C' C'' C''', and in a level as far as the point B, and it is to be found at C' by three feet higher than the bottom of the river at A; and uniformly proceeding always upon the same line it is placed at Cv, by six inches lower, than the above-mentioned point B, and distant by about 160 *trabucchi* from it. The same point B is rising towards the north 18 inches above the


D
D
T.1.4.6
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T.1.4.6
200 Trab.

point B', which is uniformly lower again 18 inches towards the east, that is towards the dyke at E', which point E' being placed beyond the aforesaid rising ground, is about 55 *trabucchi* distant from the bank of the river. Proceeding next from B' to the west along the line E E' E'', &c. the country at E''' is lowered by six inches, that is to say, the point B is by twenty-four inches higher than the point E''', and being higher than B by eighteen inches, is placed at the same horizon with the country towards the dyke, where the said country is by three feet higher than the bottom of the river.

Going towards the south along the line B B'', the land at B is lowered by fifteen inches, and from B'' towards the banks of the river is also lowered by fifteen inches at the point F', and twenty-one inches from B'' along the line F F' F'', &c.; that is to say, the point B is by thirty-six inches higher than the point F''', and by thirty inches higher than the point F' towards the river. The whole may be seen by the profiles A A' A'', &c. B B' B'', &c. D D' D'', &c. F F' F'', &c. C C' C'', &c. E E' E''.

This land being woody along the banks of the river, and by a tract between east and west, where a branch O O deserted, is to be in some way crossed, in order to irrigate the fields which lay beyond it, and are divided from north to south by a rectilinear road, that goes as far as the point G, and proceeding further is divided in two roads, one placed on the horizon of the fields, while the other on the left side is bending below the horizon.

From the aforesaid profiles appearing, that the point B is the highest of the country, and at the same level with the points C' E, that is to say with the country which is contiguous to the river beyond the rising ground, and the same country being at A, by three feet higher than the bottom of the river, the dyke must be as high, as to convey at B a sufficient quantity of water in order to irrigate the adjacent country.

If we should wish to irrigate with the contents of the said dyke, commonly called *bealera*, about 2379 *giornate*, or day's work of land for every day, we must proceed from the experiment of *Father Regis*, " that about 67 feet of water, drawn in one hour, will irrigate 43⅔ Milanese perches, or 43,666 of sandy and uneven country; whereas the Milanese perch is containing 11094 Parisian square feet, and the linear *eliprando* foot is to the Parisian, as 160 to 253; so 43,666 perches will be equal to 193745 *eliprandi* square feet; and as 14400 *eliprandi*

square feet contain the *giornata*, or day's work of land, so 67 Parisian cubic feet of water, drawn for every hour, will irrigate, in one day, 193745 *eliprandi* square feet, or *giornate*, day's work of land, 13,4545, that is to say 13 *giornata*, or day's work of land, 45 *tavole*, or planks, five feet of the plank, and five inches; but as 67 Parisian cubic feet are equal to 16, or rather 17,946 *eliprandi* cubic feet, so in order to water in one day 2379 day's work of land, will be necessary about 29656 cubic feet of water for every hour, or 83,237 *eliprandi* cubic feet for every second of a minute, which reduced in Piedmontese *ruote*, will amount about 33 *ruote* of water. This being granted, we must observe, that in order to fix the height of the dyke, which is necessary to be such not only to draw that quantity of water which is wanted, but, besides the drainers, formed to avoid the overflowing in the mouth of the canal, as well as in the dyke, which must be lower than the banks of the river; and although the canal may discharge part of the water in time of overflowing, yet the height of the current, obstructed by the dyke, might cause an inundation, notwithstanding the drainers formed before the *balconera*, or gate-building; however, the matter being examined, it will be easily conceived, that, supposing the height of the dyke to be one foot less than that of the banks of the river where it ought to be formed, and admitting the two drainers, every inconvenience will be avoided, especially taking the precautions which we shall hereafter describe: and as the height of the right bank, where the mouth will be formed, is five feet and six inches, so it follows, by consequence, that the height of the dyke must be three, and no more than four *eliprando* feet, we shall admit the height of three feet only towards the right bank, that is to say, towards the mouth of the canal of irrigation, and three feet and six inches towards the left, or rather our dyke shall have a declivity of six inches from the right to the left bank. This seems, at first sight, to be of little consequence, yet because the water will always rise for a while over the brow of the dyke; and, because by so rising, as it has been observed, the floating matters, at a very short distance from the brow, have at once a strong velocity, this being the effect of the next water-fall, so that such a declivity of the brow of the dyke will greatly add to the strength of the channel towards the mouth. Let us read what Doctor Bacciali wrote upon this subject in the fourth volume of the Acts of the Bolognese Institute, this, in my opinion, being the best author on practical cautions, which are necessary for the construction of similar dykes over the rivers.

Our dyke shall be built with three rows of stakes, stuck up in little squares of five, that is to say, the stakes of the second row must be in the middle, or the center of four; these stakes having a diameter of six inches in the two first rows, and eight inches in the last, or third row, shall be fastened towards the brow by boards fixed at the top of the same stakes, diagonally crossed, as it may be seen by the profile annexed to the general plan. The spaces between these stakes shall be filled with well settled stones and pebbles. Behind the first row, and along the whole dyke, there will be some boards perfectly joined, and nailed to the said row, as well as to the lateral banks of the opening left in the dyke, so that the said stones and pebbles may be kept fast in the dyke, which in its breadth will have a declivity of about three inches: that is to say, the stakes of the first are bent, by three inches, towards the third row. In order to avoid, however, that the water-fall above the brow may not damage the foot of the dyke, and that it may be sufficiently strong, there will be built behind it, and all along its length, a counterscarp, with its bottom, by three *trabucchi* broad, beginning by an angular form with the bottom of the river, and ending by about three inches below the brow of the dyke, at the third row of stakes, so that in profile might present the figure of a triangle, whose cathetus, or perpendicular lines, by three *trabucchi* long, is leaning to the bottom of the river, and the other to the dyke being three feet high, where the dyke is three feet and six inches, and thirty where the dyke is thirty-six inches. This counterscarp is formed by so many rows of stakes, six inches in diameter, placed at a distance of eighteen inches from center to center, chained together in length, and nailed to the top of other rafts, which will serve also to support the stone pavement to be formed between one and the other center, as well as that on the inside of the said rows, which shall be filled with ragged stones. All this being completed, we should treat here for a while on the precautions which are necessary in driving in the stakes, as well as in forming the tops of both extremities of the dyke; but as the argument would go too far, we shall only advert on the quality of the soil for the whole foundation of the dyke; besides that, both its tops must be well coasted by the banks of the river not liable to corrosions, and which, in contrary case, may be repaired and strengthened by walls, &c. The head of our dyke, on the right side, being propped by the bank of the river, makes a mixtaline triangular vacuum, whose sides are both formed by the

dyke, and its basis by a part of the bank, which is placed between the end of the dyke and the mouth of the canal of irrigation. However this void must be filled up by a palisade of the same height and construction of the dyke, so that the water may easily take its course into the mouth of the canal.

This mouth-piece beginning by four *trabuccbi* in breadth, will go on narrowing almost in form of a funnel, so that the water finding the entrance more wide than the breadth of the canal, may run very easily through it. The sides of this mouth must be formed of the best stone work, which from the upper part will be extended by a considerable tract along the banks of the river. Thus, without making any angle in the windings, but with gentle curvities, the mouth-piece will be more strengthened and secured.

We are taught by the science of hydraulics, and by experience, of the bad effects occasioned by the force of water against sharp angles, that it is necessary all rectilinear angles should be avoided not only in the breast work, but in the form of pillars also, of bridges, and every other building in the water; and that all such angles must be blunted in gentle curvities, so that the water may easily flow by the works without occasioning the least friction, provided these works be laid on good foundation. At the mouth of the canal, and on the very bottom of the river, there will be a stone pavement supported by good foundations on piles, and of the form, figure, and declivity, as by the profile, see Plate V, in *longo del naviglio*, or in length of the canal of irrigation: the walls of the mouth-piece must be continued as far, as behind the *balconera*, or gate building. This stone pavement must be raised as high as R, by one foot above the bottom of the river, so that all friction at the head of our canal will be entirely prevented. The point R, see Plate III. being as a limit, or fixed point, where the excavation of the canal must begin by four *trabuccbi* in breadth as before mentioned, in such a manner however, that the bottom of the canal may always keep the same level with the point R,) by a length of fourteen *trabuccbi*, at the end of which it must be raised to S by a step of three inches. This first acclivity will serve to break off a little the velocity of the river, notwithstanding the water running into the canal might be conveyed by the overflowing of the dam; and will likewise serve to prevent the settling of the matters brought down by the river; but still all this would not be sufficient to avoid every inconvenience, if the matters had not some outlet; and for this purpose there should be at T, on the left bank of the canal,

a trench* one *trabucco* broad, with a corresponding canal to let out and discharge them with the surplus water into the river. By this means part of the overflowing being discharged, the canal of irrigation would obtain the advantage of having the water as high as it is required, adverting that the height of the water in the canal of irrigation must be such, as in time of dryness the owners might not want water to irrigate their fields. Moreover, as the water contained in the canal must be about 83,237 cubic feet for every second of a minute, so it is necessary also to determine the breadth of the same canal, which being multiplied by the height of the water may give the total of an area, as it is wanted; so that in the place where the whole body of the water in the canal must be measured, and ascertained, this area being multiplied by that velocity, which corresponds to $\frac{2}{3}$ of the height of the running water, might give a total of about thirty-three *ruote* of water for every second of a minute.

The mouth of the canal was fixed to be twenty-four feet, or four *trabucchi* broad; but such a breadth might be excessive, as much as it is necessary to facilitate the entrance of the water; therefore, having already determined the breadth of the mouth-piece, we shall now proceed to fix that of the canal, in the place where the total distribution is to be modelled and measured: the clear breadth at that place will be eighteen feet, or three *trabucchi*. The measurement for the distribution must be done in time of low water in the river, when the want of irrigation becomes more urgent. This place for measurement will be such as having determined the distribution, might serve also to let out the overflowings, so that the fields might not be damaged. Such a place must be chosen in the body of the canal, where a building commonly called *balconera*, or gate building, is to be formed with a corresponding trench, or canal of discharge.

Having determined the breadth of the area, we find by calculating as before described, that the height of the water at that place must be one foot and six inches, in order to have the quantity required.

Admitting this, we shall avoid the sad effect of the overflowings in the canal of irrigation, by putting at S a cross-piece (*see the Plan, Plate III.*) formed with beams, directly crossing both banks of the canal, and at some height above its bottom, so that the water forced to pass under the cross piece may be stopped in its overflowing, and take its course behind, and thus be discharged by the trench

* Or Wier, as called by English engineers.

formed at T; but as we must advert, that the height of the cross-piece be not so little as to obstruct the required height of one foot and six inches, as above fixed to the *balconera,* or gate building; so from the point, immediately and perpendicularly falling on the bottom of the canal, by the middle of the cross-piece called *brida,* it is usual to give another little elevation to the bottom of the canal by three inches high, and thtee *trabuccbi* long, measured from the edge of the step immediately corresponding on the bottom of the canal, to the cross-piece. This being fixed, the height of the *brida* or cross-piece, from the said point or step will be equally determined; that is to say, the cross-piece must be one foot and six inches distant from the bottom of the canal, which is the required height of the water in the canal, beside the acclivity of three inches, by three *trabuccbi* in length, given to the bottom of the canal, which is horizontally running by five *trabuccbi,* as far as the *balconera* or gate building, which is eight *trabuccbi* distant from the step, or from the cross-piece.

This building called *balconera,* (Plate I.) is forming a square of four *trabuccbi* sideways, measured from the inside of its walls, as by the drawing annexed to the general plan. We must however observe, that this building admits but a clear breadth of eighteen feet, for the water running through the canal, in the middle of this edifice, and at the entrance of the water, there being a pilaster two feet broad, by which the banks of the canal are insensibly narrowed by four feet from the cross-piece to the said edifice, called *balconera,* where the canal continues by two openings of nine feet each broad; that is to say, the clear breadth is here eighteen feet as before-mentioned, the openings being divided by the pilaster, two feet broad. Besides these two openings giving passage to the water, there will be in the *balconera* four other openings, with gates to be shut up, when wanted; two of which being towards the south, will give vent to the surplus of the water, in time of overflowing, into a canal Q, or trench ending in the river, as it may be seen by the plan. The two other openings towards the west, will give course to the water of the principal canal, and must be shut when the canal is to dried up, as it is well understood, that these canals must be cleared some times in the year, from the matters carried by the river. The whole building called *balconera,* and its dimensions, are sufficiently described by the drawing, purposely made in full length; therefore I shall only say, that the whole mechanism in lifting up the gates according to desire, has been simplified as much as possible.

Each wooden gate, as by the large drawing, is sustained by two chains, or two iron machines, which are joined in one point, to which is tied a rope, perpendicularly passing over a pulley C, hanging at a beam; from which pulley, passing perpendicularly again, goes to meet another pulley B, put also with its diameter perpendicular to the horizon: from this pulley the rope horizontally running goes to turn itself round another pulley D, which hangs with its diameter parallel to the horizon, and unwinding itself from this last pulley at a right angle, goes to a windlass A put in the centre of the edifice called *balconera*.

From the reasons already alleged, where the principal canal is to be dried up, and cleared from the matters, it will be necessary to measure the total quantity of water at the said *balconera*, or gate-building.* Since, by the acclivities of the bottom of the canal from its mouth to the said *balconera*, by the narrowing of the banks of the canal by a tract as far as the *balconera* or gate building, and by its distance of 25 *trabucchi* from the river, as well as by the tract of five *trabucchi* preceding the two first gates, the current of the water by its velocity may be calculated at $\frac{1}{4}$ of its height, which is fixed to one foot and six inches, having thus prevented, by the above precautions, every attempt which the water entering the canal through the natural velocity of the river should be forced to make. We must finally advert, that the water coming from the river is conveyed into the canal by the overflowing of the dam crossing it, as it will be hereafter demonstrated, that every velocity which should be occasioned by a water fall, shall be prevented by an acclivity very distant from the said building called *balconera*.

Beyond this building the canal of irrigation is continued by a tract of twenty *trabucchi* horizontally; but although every settling of matter before the *balconera* has been prevented, yet it is not to be denied, that from rivers like ours, some matters, though small, still hurtful to the meadows, may be conveyed even beyond the *balconera*: therefore after these twenty horizontal *trabucchi*, the bottom of the canal will be continued by a tract of fifty *trabucchi*, with a declivity of six inches, at the end of which the said bottom must be raised again by six inches, for a

* Every time that the canal must be drained, the quantity of the water ought to be previously measured, and thus especially with the concurrence of a person representing the owners, who will have some claims to present, if the man appointed to direct the canal at the gates is not trusty. The canal being drained, and cleared from the matters, its bottom will have a proper declivity.

tract of fifty other *trabucchi:* the point fixing such a length will be horizontal with the ground, which is going horizontally by five *trabucchi* before, and by twenty *trabucchi* after the *balconera*. This ground is raised by one foot and six inches above the bottom of the river remaining still one foot and six inches to reach with the bottom of the canal to the level of the dam; and as we have supposed, that even in time of low water in the river, that which is discharged from the dam may have a sufficient height above the brow; so after the last fifty *trabucchi*, during the extent of which the canal was raised by six inches, this acclivity may be continued, by one foot and six inches, as far as the first derivation or opening B.

In the mean time it will result, that between the declivity, by a tract of seventy *trabucchi* from the *balconera*, including also the twenty horizontal *trabucchi*, and the acclivity of one foot and six inches, or rather two feet, by a tract of 146 *trabucchi*, as far as the first opening, there will remain a cavity in which the smallest matters may be laid without being carried into the openings, or little mouth-pieces, which serve to irrigate the meadows; and thus it will be known the effect of a greater height than that of the cross-piece by one foot and six inches over the horizontal plan of the *balconera*.

After the first opening, or derivation B, the bottom of the canal follows, descending with the level of the country. From this sort of canals only, and in no other case, some advantage and security may be derived, since it is easily conceived how many damages and dangers may be encountered, where the nature of the river, the position of the dyke, or the precautions mentioned in the plan, are wanted; therefore the river and the canal must have the banks made in masonry, mould, or otherwise, and have also the height marked in the profile at its proper places.

The first derivation, or opening B, is distant by about 216 *trabucchi* from the gate-building; the water may be drawn from that opening to irrigate the country bordering in the vicinity of the cross-piece, and having at one side the canal of irrigation, and at the other the line B B', and, if required, continuing indefinitely towards the north. The owners of the fields to be watered may have a privilege of drawing two *ruote* and $\frac{1}{2}$ of the *ruota* for every second of a minute. To that effect, as the water of the dyke, called *bealera*, is one foot and six inches high, so that at the opening will be one foot, and the remaining six inches may serve as

water-fall, as it is most usual, especially in Piedmont, to apply water falls to the openings, or mouths of derivations, *as by the profile.*

By working with the set form $Q = \frac{11}{18} P^2 \frac{2}{3a} . (\overline{6 + a} \times \sqrt{\overline{6 + a}} - 6 \times \sqrt{6})$ $P^{\frac{1}{2}}$ the breadth of the opening will be found of twenty-four inches, therefore the area P^2 will be of 288 square inches, and $\frac{11}{18}. P^2 = 176$ square inches, and $\frac{11}{18} P^2 \frac{2}{3a}.$ $(\overline{6 + a} \times \overline{6 + 6} - 6 \times \sqrt{6})$ $P^{\frac{1}{2}} = 12905,87$ cubic inches for every second of a minute, or *ruote* of water 2,96, which was required.

Likewise this quantity of water may be regulated, and distributed in different times. Suppose that all the water running through this mouth-piece be only for thirty hours in the week, that is to say, the mouth-piece be only open for thirty hours in the week, and by the time that it will remain shut, all the water will entirely run to the canal of irrigation. These thirty hours, supposing to be divided in three times of ten hours each, for instance, ten in Monday, ten in Thursday, measuring the time from the break of day, and ten hours in Saturday, beginning from one o'clock afternoon, it is evident, that such supposed distribution of time would have no effect, but upon the remaining grantees of the canal of irrigation, and not yet upon those of this first derivation, or mouth-piece.*

In order to form an idea of the distributions for the grantees deriving little watering canals called *bealere ;* suppose five to be grantees of the water from the first derivation; the water drawn must be conveyed by an horizontal little canal from B into A, where three grantees may draw water by the little mouth pieces *a, b, c* ; the grantee of the opening having a right for three hours of water, may be the first of making use of it, and irrigate the field situated between the little canals *a d, d f,* and the line *a* B, adverting that the bottom of his little canal *a d,* may be horizontal as much as possible, so that with a gate, or a piece of board, he may be able to rise the water into the little canals; and by putting into the little

* According to the quality of land, its irrigation will be more or less frequent. I have taken a rule to fix the quantity of water to the *balconera,* or gate-building ; that is, the land being of bad quality, may be watered once or twice a week, or every fifteen days. This has no influence upon the generality, since there is no other rule but that of making experiments upon the quality of the ground, in order to determine the manner of irrigations exactly ; in the mean time the matter is not so difficult, being very often decided by our judges and magistrates, in cases of contentions between the grantees.

irrigatory canals *g g*, *g g*, *g g*, some wooden obstacles, as pieces of boards, moveable at pleasure, the water may swell, and pour itself over the fields. This operation must begin by the first little canal *g g*, being the nearest to the mouth-piece *a*, and successively by the other little canals *g g*, *g g*, into which all the water must be conveyed, having its course through a subaltern canal from *a* into *d*. This canal being two feet broad, is properly called *asta*.* These little canals, or trenches, having the same declivity with the country, their breadth is two feet, while the distance from each other, and especially from the beginning to the canal called *asta*, is no greater than ten *trabucchi*. Such is the idea of irrigation in Piedmont. A part of the ground, which has been watered according to the custom of Piedmont, and comprised between the lines B B', and C C', towards the river, is to be seen in the plan.

Supposing there is at *d*, a grantee for six hours of water every eight days, the quantity allowed to him through the little canal *d f*, conveying the water to his fields, will be all that which is conveyed into B during six hours. This second grantee having made use of the water, next comes the other, having a right for eight hours, every eight days, along the canal called *asta e* C', through the mouth-piece *e*, which is in continuation of the said canal, he will make use of the water for one hour in the same day with the grantees of the two mouth-pieces *a d*†, and the remaining seven hours in another day, when the principal mouth-piece B of derivation may be open; and this second day should be, for instance, fixed on Thursday, in which the use of the derivation B is permitted: these three grantees have in common the quantity running from one of the above-mentioned three mouth-pieces, or openings; that is to say, from the mouth-piece A: and this division relative to the time in the week is commonly division by *Samboira*.‡

* These little canals are usually one foot, and sometimes one foot and six inches broad.

† These divisions are only hypothetical, but it is well understood that they will always have some respect to the quality and quantity of the ground, taken in general.

‡ The word *Samboira* depends intirely on the idea attached by our peasants irrigating in any day in the week, be it whatever it may, this being peculiar to Piedmont only. The irrigation in other countries is practised every eight, ten, or fifteen days, as wanted, when it is very often adopted; the division by unities, or inches of water, expressed in these words, so many hours, or so many inches of water.

Let there be at C, a grantee, having his little mouth-piece contiguous to that of the grantees of the mouth-piece A for the irrigation of their fields. Such a grantee conveying his water through the little canal C B', and his grant being for nine hours in eight days, will have the three remaining hours of Thursday, and take again the six other hours in Saturday, at one o'clock in the afternoon; conveying thus through his little canal C B' the water to its destination. Finally, the grantee of the little mouth-piece *b*, for four hours in eight days, will draw the remaining water of the opening, or derivation B, and irrigate the land situated between the subaltern canal called *asta b* B, the road, and the *asta*, or canal *d* B'.

This ground, as by the plan, is watered in a manner different from the Piedmontese. The distance of the little irrigatory canals *g g*, *g g*, and is also about ten *trabucchi*; but these are crossed by other little canals, or cuts *o o*, *o o*, *o o*, which by the side H H, have their banks by one half, and even by one quarter of an inch lower, than the banks to the right *o o*; so that these transversal little cuts turning the water, which runs through *g g*, if not hindered, this water pours itself over the country; and from one *quadretto*, or square, to another, a man alone can water much more ground than is done in any other of the usual methods. These transversal little cuts never terminate to the next contiguous irrigatory cuts *g g*, but to the points *z*, *z*, *z*, they have their bottom, which is on the level with the watered country. In this manner the water remains longer over the fields, which being of lighter mould would easily become dry, should they be otherwise moistened. These little cuts *o o*, *o o*, have moreover their bottom raised, that is to say less deep, than the little cuts *g g*, *g g*, by about six inches. Such is the practice of irrigation in the Canavese province, which, like Piedmont, derives the greatest part of its revenue from it. This method, however, is used in that sort of ground wanting more moisture; although the Canavese territories are generally of light mould. The usual method is exhibited in the plan by the fields, which are contiguous to those above mentioned, that is to say, to the right side of the principal canal beyond the road G G, and extending towards the south, as will be hereafter explained.*

The second opening, or derivation, being placed in order to the left side of the principal canal of irrigation, is marked with the letter L, *as by the profile*. This opening is distant, by about fourteen *trabucchi*, from the derivation B, providing, in the course of time, four grantees with necessary water through the little

mouth-pieces *b, m, n, s, q*. This opening is two feet broad, like the foregoing at B; its clear height, as by its form, being one foot and three inches. So that reckoning the value by six, by P^2, which is the area, and considering that the water running through the principal canal of irrigation is also one foot and six inches high, the water-fall will be 3 inches. Therefore the set form $Q = \frac{11}{18}.P^1 \frac{2}{3a}.(\overline{6+a} \times \sqrt{\overline{6 \quad a}} - 6 \times \sqrt{6})\ P^{\frac{1}{2}}$ becomes $220 \frac{2}{45}.(71{,}1714).\ P^{\frac{1}{2}} = 14893{,}17$ cubic inches for every second of a minute, making 3,4192 Piedmontese *ruote*, or 8,6193 *eliprando* cubic feet of water running the whole of Monday; that is to say for twenty-four hours, and fourteen hours on Saturday, beginning at day-break; hence the grantee of the little mouth-piece *b*, will have the use of the water for six hours on Monday, while that of the mouth-piece *m*, will take it for twelve hours in the same day, being both obliged to let the surplus run through the dyke *b, m, n, s*, F''; and the flowing out from the little mouth-piece *b*, watering the ground situated between the *aste*, or canals *b s, b u, s t*, and *l a*, must be discharged into the canals *s t, u t*, for the benefit of some owners of the lower fields, as for instance, that at *t*; then the grantee of the little mouth-piece *m*, watering his field, situated between the canals *m p, m n, n q*, and the road towards the south, must let run the flowing out of his irrigation into the *asta*, or canal *m n q*, for the benefit of the grantee receiving the water at *q*, and making also use, in his turn, of the canal *n q*, and of his little mouth-piece *n*, with which he irrigates his fields situated between the canals *n f, n q*, and the road, which is like a basis of this triangle. The water runs on Monday for six hours through this little mouth-piece; the overplus which may be spared from the irrigation of this space of ground, will serve to water that which is situated between the two roads, by conveying the water through an aqueduct, built in masonry, under the road G, issuing at *r*, where is the head of another *asta*, or irrigatory little canal.

Finally, the fourth grantee is watering by the little mouth-piece S, making use of the *asta*, or little canal S T, which discharges the overplus; and also the flowing out of the irrigation from the little mouth-piece S, into the little canal *t* F', for the benefit of that grantee who is entitled to the use of the flowing out, and in Monday making also use of the surplus out of the little mouth-pieces *b, m*. These *aste*, or irrigatory canals, are usually two feet broad. Such is, in general, the method of distribution of water in some places, where it is sparing, and even where

too much moisture would be hurtful, such as some places in the provinces of *Vigevano* and *Lomellina;* and yet I do not know by what paradox they cannot make use of moisture, by which these places are surrounded, although they need watering in order to give an income, which is certainly not indifferent. I do not pretend to give a reason for this: the enlightened Prince will give a better one to himself, which I could not be able to do, but to advert only, that the irrigations in these countries are not so frequent, but sometimes from ten to ten, and even from fifteen to fifteen days; and as we are mentioning the provinces of *Lomellina* and *Vigevanasco*, let us say something about their method of conveying water to the fields, which method is similar to that of the province of *Novara*, and in some respects to the *Vercellese*, whose land is composed of a very strong heavy mould. Instead of irrigatory little canals, as are used in other countries, they make use of little projecting pieces of mould, $g'f$, $g'f$, $g'f$, where, considering that the land between the road G G, and the river, has a declivity towards the said river, and another towards the south, so they give the declivity to the projecting pieces $g'f$, $g'f$, the same as that of the land towards the south, in all their length, beginning at g', as far as the end at f', where these projecting pieces are levelled with the country.

The meadow laying between these projecting pieces has the same declivity as the land towards the river: these projections have a little height, not exceeding two inches of our *eliprando* foot, diminishing towards f; on the side of the road they are raised by that scarp, or foot, generally formed by the mould itself, and on that of the river they are lost to the sight, or, more properly speaking, their step, or foot, is insensibly bending, and at last levelled with the ground to be watered. At the beginning of each of these projections, that is to say, towards the little canals $b\,u$, $m\,p$, $n\,q$, $t\,s$, and near to their banks at g', g', g, &c. there is a little opening in the places e, e, e, and in the bank of the canal, where the water is entering, and it is conveyed near, and along the said projections, which by their declivity towards the ground to be watered, they uniformly pour the water over it: hence it is sufficiently understood, that the *aste*, or little irrigatory canals, have two banks, one that is towards the place for irrigation being lower, and the other higher; the bank towards the irrigation being sometimes a little opened, with the spade at the places e, e, e, and in a right line from the projections $g'f$, $g'f$, $g'f$: this admitted, we observe with what facility a single man is able

to irrigate a vast tract of land in a short time, provided the country, as well as the projecting pieces, called by the Novarese *coste*, or hillocks of meadows, be well formed and levelled.

The grantee for the use of the little mouth-piece *m*, wishing to irrigate the piece of ground *m p q n*, the water which is running through the little irrigatory canal *m p* being allowed, he shuts his little canal below the projecting piece *g'*, that is to say at *e*, which is placed towards *p*, the water rising, runs along all the projections *g' f*, *g' f*, *g' f*, *g' f*, thus all begin at once to pour over, because we always endeavour to apply the levels coincident with that of the little irrigatory canal, as well as to the projections and to the flat ground, so that all may work almost at one time. A longer detail being unnecessary, I shall say that the openings made to the banks of the little canals must be formed more or less deep, in proportion as the little canal is lowered or raised above the level of the country. This grantee, in time of irrigation, will have no more want of keeping his little canal *m p* shut up; and the water, after having taken its course, and being a little swelled over the country at the end of these projecting pieces, will pass along the line, which, it is supposed, running through the extremities *f f f*, and thereby it will flow into the little canal *m n s* F'' for the benefit of the mouth-piece *n*. The same method, as we conceive, is practised by the grantees of the little mouth-pieces *b n s*, the first of them will make use of the little canal *b u*, which being shut up at *u*, will irrigate the piece of ground *b*, *s*, *t*, *u*; the second grantee of *n* having the use of the little canal *n q*, will water the piece of ground laying between the road on the left, declining southward, and the little canals *n q*, *n s* F''': and the flowing out of the water will continue its course into the *asta*, or little canal *n s* F'', and the surplus will pass through *q*, below the road, to irrigate in the same manner the other piece of ground laying between the two roads; this being done by the means of a conduit with water-fall, as the grantee is not permitted, by some stipulated contract, to make any open canal crossing the road, no bridge being there practicable. We shall speak hereafter something about the form and construction of these conduits conveying water under ground from the level of a field to another a little distant; suffice for the present to say, that this construction is entirely founded on the theory of communicating tubes.

The grantee of the little mouth-piece at S will water his field in the above described manner, admitting that the land-owners, having the use of the principal

canal of irrigation by the inferior derivations L′ L″ placed to the left, may irrigate their fields laying between the road, which is divided by the right, declining towards the south as far as at the end of the point, that is to say westward, which fields we suppose to be of better quality, as generally are those of above-mentioned provinces.

This method of irrigation is undoubtedly better than the foregoing;* but if a projection of mould is not insensibly bent towards the levelled ground, and against the foot of the next projection, and if the levels of the ground to be watered be not quite exact, some inequality may often occur, and the product of the meadows will not be of the best quality; this is the only precaution easily to be obtained by means of the most perfect levellings. A man alone, with a single cross-piece, may be able to irrigate in one day more than 300 *giornate*, or day's work of land. The advantage arising from this method, as some owners assert, is very considerable.†

* It is understood that this kind of irrigation is better than the others, as to the economy of the work of hands, but not so in respect to the quantity and quality of the hay. This method followed by very near the whole of Lombardy, as well as that which is practised by the Canavese, have both the imperfection of letting the water at rest in the low place, which cannot be possibly avoided in meadows of great extent, and also of irrigating promiscuously pieces of hard, compact, as well as light ground, which may be found in the same meadow. Thus the quality and quantity of herbs produced by these meadows are damaged, since on firm and high ground there is but little quantity of herbs, while from the low, and too much watery places, great quantities of bad herbs and weeds are shooting out. In our method of irrigation, however, we do not encounter these inconveniences, because, besides the little mouth-pieces, which are fixed, we make use of some pieces of boards, of a semi-circular form, whose crooked side is edged: these boards, or gates, are called by our peasants Scensoire, or Bagnoire; their diameter is larger by about three or four inches than the ditches, and being very heavy, a man not used to work cannot lift them without difficulty; and as our canals for meadows have a semi-circular profile, or almost so, as to be shut perfectly up by these boards: in doing this work, the man appointed for the irrigation, lifts the vertical board, with its edge outside, over his head, and throwing it vertically, with its edge towards the bottom of the canal, and in a perpendicular direction to its banks, so that the board being fixed in the ground, the canal will be entirely shut, and the rising water be laterally discharged in that place. When this ground seems to be sufficiently watered, the man pulling then the board out, will go to fix it elsewhere. By this method of irrigation we obtain much better quality, and greater quantity of hay, according to the quality and preparation of the ground; thus the greater work which is required, is abundantly compensated.

† Order would require, that we should describe the third derivation L′; but as both methods

The fourth derivation, or opening I, usually placed to the left side of the principal canal of irrigation, is nine feet broad, as by the profile No. II. and one foot high; its bottom is levelled with that of the canal: and we must observe what elsewhere was remarked, that the height of the current in the principal canal of irrigation must be determined at every succeeding derivation, or opening, while the preceding are open, and even by the time that some of these may be shut up; previously observing that the height of the current was diminished by the derivations B and L; supposing the law, or rule of diminution of the heights of a canal of irrigation to be granted, there would be room here to enlarge upon the matter, and point out every possible event and combination; but in order to enumerate them all, it would be necessary to make a long dissertation, so I shall proceed to follow my argument without refusing to treat eventually on the preceding subject, following however the late experiment.

Supposing the height of the current at the opening I to be diminished by three inches, that is to say, to be of one foot and three inches only, so the opening I must have a water-fall of three inches: thus $Q = \frac{11}{18} P^{2} \frac{2}{36} (15 \sqrt{15} - 3 \sqrt{3})$ $P^{\frac{1}{2}} = 792 \cdot \frac{1}{18} (\sqrt{15} - 3 \sqrt{} P^{\frac{1}{2}} = 44 \cdot (22{,}8986)$. $P^{\frac{1}{2}} = 49815{,}5$ cubic inches, which make 11,436 Piedmontese *ruote* of water to be distributed to three little mouth-pieces X, I′, Y, for forty-eight hours every nine days, in such manner, however, that the grantees of the little mouths X, Y, Z, may always draw, at the same time, an equal quantity of water, which is precariously granted to them by the grantee of the little mouth-piece I′, and from the orifice I′ may be always drawn six *ruote* of water to irrigate those fields, which are beyond the canal bridge to the north. The grantee of the mouth-piece X, and that of the mouth Z, will be both obliged to let out from the canal I I the overplus to be conveyed into the litttle canal X″ X‴ X⁗. In order that this partition may succeed, let us endeavour that the bottom of the drawing canal may proceed horizontally, and with the same length of nine feet, as far as the three divisions *g*, L′ X, (*See the profile*). The water being at I, must have a declivity of nine inches, to be conveyed

of placing the derivations from the *bealere*, or dykes, with or without water-fall, should be taken into consideration, so we have thought proper to continue the description of the derivations with water-fall, and leave for the present the derivation L′ L′, with the natural order of the course of the principal canal.

under the little gate at A, which is to be lifted up and let down, as it is wanted. The grantee in the time of his irrigation shall keep his little gate A, so lifted up from the bottom, or threshold of stone at B as much as it will admit the passage of six ruote of water, being the quantity allowed to him by right. The other three little mouth pieces, X, Y, Z, being also two feet broad and the socket the three *aste*, or irrigatory canals. Continuing by a tract of one *trabucco* and a half, with their bottom at the same level with the country, it is evident that the quantity of water dispersed by these three mouths will be apparent. Because, if from the derivation, or opening I, as far as I', (see the Plan of the abovementioned profile.) the water preserves its height by one foot, and three inches, so that the three orifices X, Y, Z, on account of the preceding, and subsequent grounds being horizontal, will have the same velocity, which belongs to $\frac{4}{9}$ of the height before mentioned; moreover the said openings being of an equal breadth, it follows by consequence, that the three quantities dispensed will be apparently equal to each other.

It remains to determine yet, what must be the height of the mouth-piece I', that in time of irrigation might be dispensed no more, than six *ruote* of water, admiting the orifice perpendicularly taken to both sides of the *asta*, or canal, to be six feet and nine inches, or eighty-one inches broad.

In this case the engineers make use of the machine, or Milanese model: hence, they practically succeed to determine the height by repeated experiments with the machine, until they have the quantity of six *ruote* of water. The model however, must be constructed after the Piedmontese measure, and the Milanese inch of water must be reduced to that of Piedmont. By applying the machine behind the little gate, they succeed in groping to fix the height of the area; yet it would be more precisely determined, if the gate A were put in any other place, but at the end of a declined ground. Finally, the irrigations made by the right side of the principal canal of irrigation, and by the right of the road to the west, with the mouth-pieces X, Y, Z, are done after the Canavese method, that is, by making use of the little openings *g f*, *g f*, *g f*, derived from their respective canals, and formed almost in the manner, which is practised in order to irrigate with the first derivation from the mouth-piece C, the country C B' G B, where the method of irrigation is a part of this now mentioned. The only difference in the formation of the trenches, or cuts *g f*, *g f*, *g f*, consists in loosing sight of them in the

country, at the points *f, f, f,* and that at their head, or beginning *g, g, g,* they generally have the same depth of the transversal little canals, *i* Z *i* Z, which are in the fields watered by orifice C of the first derivation; where at *f f f* they are lost with the level of the country, as the *i* Z, *i* Z, *i* Z, are lost in Z, Z, Z, &c.

Let us now come to the three remaining mouth-pieces L' L'' L''' already mentioned: these three derivations are without water fall, and have their threshold, or bottom, higher than that of the canal of irrigation.* Thus the first L' has its bottom by six inches higher, than that of the canal. *See the Profile.* Now the height of the water in the canal of irrigation being one foot and three inches, the height of the water above the threshold will be of nine inches, the breadth of such an opening being of one foot, because the water runs in without being forced, its velocity will be that of $\frac{4}{9}$ of the height, by nine inches, and yet $Q = \frac{11}{18} P^2 . \sqrt{\frac{4}{9}} A \ P$, where $A = 9$, inches; therefore $Q = 2825$ cubic inches for every second of a minute. Thus the derivation L'' being two feet broad, has its bottom, or threshold raised by six inches; and reckoning L' the height of the current in the canal of irrigation, by one foot and three inches, so the height of the quantity passing through L'' will be of nine inches; thus $Q = \frac{11}{18} P. \sqrt{\frac{4}{9}} . A. P = 5650$ cubic inches every second of a minute. *See the Profile.*

The sixth derivation, and the last in the drawings, being also placed on the left side of the canal of irrigation, is four feet broad, the bottom of its orifice being by eight inches higher than that of the canal. *See the Profile.* It is well understood that the height of the canal is fourteen inches, while the height of the water above the threshold of the orifice will be found six inches: therefore $Q = 6151$ cubic inches for every second of a minute.

Let us now mention the *tombino*, or water fall conduit, which is formed under the road G, from east to west, as by the profile annexed to the general plan. The water coming from *q*, and descending over a declivity for about one *trabucco*, runs horizontally under the road for a tract of about two *trabucchi*, and five feet; hence rising over a declined ground, it is conveyed into the canal *r*, whose bottom is placed almost at the same level with the canal *q*; the declivity of the canal bent by *q* is four feet by the height of one *trabucco*, and towards *r* it is five feet

* This derivation L' should be the third in order, being left to be above described, which is placed to the left side of the bridge, crossing the canal of irrigation.

by the same height. This canal is two broad by eighteen inches high : its bottom is formed concave in a circular line, forming a semidiameter of three inches broad, such a curvature being adapted to prevent sediments, and especially on the side of *g*, where the water running, might lay down sand, and other matters. Notwithstanding such precautions, some sediments will occur, by the water losing that strength, which it should naturally have by the ascent, so this canal not having a sufficient height to receive some drainers, it has been covered with freestones, which shall be occasionally removed from such places, where drainers should be formed. The construction of this water-fall conduit is apparent from the profiles.

From this perhaps too short hint of our best known methods for drawing water, and for irrigation, I shall proceed to say something about the custom adopted in watering the hills, and sometimes even the mountains, since the peasants of the hills very often use that proverb, which is common amongst those of the vallies—

> "*Who waters his land once more than his neighbour,*
> "*Shall gain a pair of ear-rings to his wife's pleasure.*"

We remarked in the description of the river, that on its left bank towards the south, there is a hill, or eminence, on the top of this hill a little lake, or well, from which are derived the various rivulets $q\ R$, $q\ R$, $q\ R$, which are crossed either by stones, or by little dikes of mould, in order to irrigate that part of the hill, as it may be seen by the plan.

Supposing on the side of the river at A, the height of this hill to be about eighty-four *trabucchi*, measured from the bottom of the river up to the little lake; and that its form is almost pyramidical, and tilled in vineyards, meadows, fields, &c. &c. That after a declivity somewhat steep, this hill, forming a surface much less bent, and afterwards a declivity divided into several planes, or steps, similar to an amphitheatre, is ending to the river. This method of dividing land by steps is peculiar to the mountaineers, who by the scarcity of land are obliged to take every possible advantage. This custom is very useful in the provinces of *Aosta*, and in the valley of *Susa*, where they divide the land by so many steps, each being supported by little walls in stone-work without mortar. This mountain on the other side north, is divided by various declivities, which end at the banks of the river. Those mountaineers endeavour to take likewise

advantage of the declivities of the hills, adapting them to the levelled ground, which is to be watered, so that a little quantity of water, which is derived from the rivulets *q* R, *q* R, may be all used for the irrigation of that ground, which is intended to be watered. As soon as one of these lateral rivulets comes to some of these levelled grounds, there the little dykes *g f*, *g f*, being formed sufficiently strong as to keep in the rivulet as far as to that piece of ground, may hold the water until it comes to it. All this is performed with a perfect understanding, and by a law established amongst neighbours, so that contentions about the time, or the measurement of water, seldom occur. Here, as water is very scanty, since wells and lakes on mountains are never abundant, so good faith alone can regulate the distribution among these industrious people.

Brevity, to which I was bound for fear of being prolix, obliges me to put an end to this work, too well knowing that the reader is persuaded, that such a subject, if well treated, would require a large volume; therefore, with the most respectful deference,

I am, &c. &c.

(Signed) MICHELOTTI,

Professor of Mathematics in the University of Turin.

N.B. For want of some drawings sent to Lisbon, of which there are no copies left, this manuscript is somewhat defective, although not in any material point.

No. XXVIII.

In the admirable Lectures read to the Board of Agriculture by their Professor, Sir Humphry Davy, *that great Chemist, in treating of Animal Manures, took occasion to consider a substance much used in South America, called* Guana, *being the dung of Sea-Fowls; and from certain experiments which he made upon it, determined that it was of all others the most valuable: it was regretted, that so little was known experimentally upon the application of this substance in practice; the receipt therefore of the following letter of the Honourable* Alexander Beatson, *Governor of St. Helena, was considered as particularly interesting, and induced the Board to order the publication of it in this work, notwithstanding its having been already printed in the Number of the St. Helena Monthly Register for January,* 1811.

Experiments in the Culture of Potatoes, upon the Island of St. Helena. By Colonel Alexander Beatson, *Governor, &c. &c. &c.*

In a place which has, for many years, been almost wholly dependant on foreign imports for the common necessaries of life, and where neither commerce nor manufacture finds employment for industry or exertion, there can be no duty more incumbent on persons entrusted with its management, than a due attention to those means that are the most likely to augment its internal resources.

From the earliest period of its establishment (in 1673) to the present time, the most positive orders to favour and encourage agriculture have been sent by the Honourable the Court of Directors. It is, therefore, in obedience to those repeated orders, that I have endeavoured to discover the capabilities of the soil, and the modes of cultivation the best suited to the circumstances of this Island. I have, accordingly, in the Abstract of the Laws and Ordinances, and in the Papers relating to the Goats, embraced every occasion that offered of stating the results, and of introducing my opinions. I have also, I trust, proved, that immense

advantages would arise to the land-holders if they were to allot a certain selected portion of their pasture-lands to the culture of corn and artificial grasses, to the planting of trees, and to the introduction of hedge-rows.

Those opinions being founded on a variety of experiments, and the results having been most carefully ascertained, under my own inspection, I can vouch for their accuracy. I feel a confidence, therefore, that whoever may hereafter make similar trials will not be disappointed. But I must here apprise experimenters, that a first crop, from land newly brought into cultivation, is generally much inferior to the succeeding ones.—I found an acre of land, which, upon breaking up, produced only 324 bushels of potatoes, yielded a succeeding crop, planted immediately after, of 522. I ascribe this improvement to the repeated stirring of the soil, by which the fertilizing influence of the rains and atmosphere was admitted. Upon these two crops no manure was used; and as potatoes are known to exhaust fertility, it might have been expected the second crop might have been less instead of greater. Hence, it seems probable, the deterioration of the soil does not take place until some time after the land is brought into cultivation.

Mr. Tull, an Oxfordshire gentleman, who published a Treatise on Husbandry, about forty years ago, speaking of the great advantages of frequently stirring and pulverising the soil, relates that a little farmer, having prepared his field for sowing, could not raise money to purchase the seed until he had lost the season; he therefore kept on ploughing, at proper intervals, until the next season arrived, when he compassed to plant his field. At harvest, his crop was so abundant, that its value was more than sufficient to pay the fee-simple cost of his field. The effects, from frequent stirring of the soil might readily be determined, by comparing the produce of a square rod of ground, planted with potatoes after being stirred four or five times in as many months, with that of an adjoining space, of the same extent, planted at the time of breaking up.

On my arrival, in 1808, I was desirous of obtaining information upon the modes used here in the culture of potatoes: but I soon perceived, from the vague method of estimating the produce by the returns from the seed sown, without any account being taken of the quantity of land occupied by the crop, that no useful deductions could be drawn, nor any comparison made between the potatoe lands here and those in England.

I learnt, however, that two crops (or more) annually were obtained from the

same land; and that these were had, in a continued succession, during a period of 12 or 14 years, without the application of any sort of manure. This, I confess, surprised me. I heard also of "self-sown crops," that is, of leaving in the ground, at the time of digging, a certain portion of the potatoes for a succeeding crop.

This unusual course of husbandry led me to infer that a much better mode might be adopted (which is indeed practised by some of the gentlemen-planters); and, in order to satisfy myself on this point, I resolved to commence a series of experiments, which should embrace the following essential points in the culture of potatoes; the proper depth of planting—the best sort of seed—the advantage of the row culture—and the improvement by manuring.

The returns of 10 or 15 bushels for one sown, were, in general, deemed good crops; but my experiments have proved that these are very inferior to what can be obtained under a different course of management.

Supposing 18 bushels to be the usual quantity of seed required to plant an acre, the returns above stated would be no more than 180, or 270 bushels per acre. According to the following table it will be seen, that by the row culture, and the aid of manure, the acreable produce of the potatoe lands may be augmented, upon an average, to nearly three times those quantities. What an advantage is this, in a place where the scanty means of labour are generally complained of!

It will be observed, by the table of experiments, that the greatest produce was at the rate of 648 bushels per acre. This was from No. 5, in the division manured with horse-dung: but even a greater rate of produce was had from a portion of the unmanured acre, which yielded the 522 bushels beforementioned. I ascertained that 30 feet of the rows of this acre, twice repeated, and taken indiscriminately, produced of fine large potatoes 52 pounds: or, as will be hereafter explained, at the rate of 674 bushels per acre.

This was also greatly surpassed by an experiment upon one kidney potatoe. It was cut in eleven pieces, which were planted in a single row, at one foot asunder, on the 5th of April, 1810, upon ground very highly manured with hog's dung. Nine of the sets only came up, and these occupied one row that measured nine feet. On the 8th of August, 1810, when the haulm had fallen, the potatoes were taken up, and weighed 21½ pounds avoirdupois; which is in the proportion of 929 bushels per acre.

Those well ascertained facts will, I hope, draw the attention of the planters to

the row culture; and to establishing farm-yards, and hoggeries, for the purpose of manuring their lands. They might then make experiments for themselves, which, I am confident, would soon induce them to change their present modes of husbandry; because these are evidently far less profitable, and must, in the course of time, infallibly exhaust, and ruin their plantations.

The spot selected for experiments is in the front garden at Plantation House. It was exactly a square chain, or the tenth part of an acre; and was, at first, divided into four equal parts for the manures, according to the black lines in the following Diagram:

	Class 1.				*Class* 2.				*Class* 3.				*Class* 4.				
	Seed the size of walnuts, planted whole.				Large seed cut in pieces.				Eyes, middle sized potatoes.				Small potatoes planted whole.				
Depths	12	9	6	3	12	9	6	3	12	9	6	3	12	9	6	3	of planting.
	Horse Dung Litter, 35 loads per acre.																
No. of the	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	experiments.
	Hog's Dung Litter, 35 loads per acre.																
No. of the	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	experiments.
	Guana; or, Sea-Fowl Dung, 35 bushels per acre.																
No. of the	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	experiments.
	No Manure.																
No. of the	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	experiments.

66 feet. (left side)

66 feet.

The figures 12, 9, 6, 3, represent the depths of planting in inches, and the positions of each two rows which traversed the manured and unmanured parts. The numbers 1 to 64 shew the situations of the experiments. The three narrow paths which separated the manured divisions reduced the cultivated space from $16\frac{1}{2}$ to 15 feet: each experiment upon the two rows consisted therefore of 15 feet in length, or of 30 feet of rows; which, as will be hereafter explained, is the 726th part of an acre.

The manures were evenly spread over the beds in the orders and quantities

specified in the diagram; they were then trenched one spit deep into the soil. The transverse dotted lines mark the spaces for each class of seed, and by crossing the manure divisions they formed 16 squares, containing each four distinct experiments; so that the total number was 64. The soil was rather stiff, being composed of blackish mould intermixed with friable fat clay.

The whole being thus prepared, the seeds were dibbled in at their respective depths, on the 9th of August, 1809, and the produce was taken up on the 30th of November, that is 113 days after planting.

The following table of the results, exhibits the produce of each experiment, or 30 feet of rows, in pounds; the weight of the six largest potatoes; and the computed acreable produce in pounds, and in bushels.

Table of the Results of the Experiments, exhibiting the number of Pounds that each 30 feet of rows yielded, the weight of the six largest Potatoes from each experiment, the computed acreable produce, in pounds and bushels, and the total quantities produced from each sort of seed, at the several depths, throughout the manured and unmanured parts, in the extent of 120 feet of rows.

NOTE.—30 feet of rows are the 726th, and 120 feet the 181.5 of an acre.

Class I.—Seed the Size of Walnuts planted whole.

Twelve Inches deep.

Number.	MANURES.	Produce of 30 ft. of rows.	Weight of the 6 largest.	Produce per acre in lbs	Produce per acre in bushels 56lbs	REMARKS.
		lbs.	lbs. oz.			
1	Horse Dung	38	2 8	27588	492	
17	Hog's Ditto	31½	1 14	22869	408	
33	Sea-Fowl Do.	38½	2 4	27951	499	
49	None	26	1 8	18876	337	
	Total	134				lbs. 134 × 181.5 equal to 24321lbs. per acre.
	Nine Inches deep.					
2	Horse Dung	35½	1 8	257 3	460	
18	Hog's Ditto	33	1 12	23958	427	
34	Sea-Fowl Do.	36	2 2	26136	466	
50	None	29	1 6	21054	375	Very stiff black clay soil
	Total	133½				lbs. 133½ × 181.5 equal to 24239lbs. per acre.
	Six Inches deep.					
3	Horse Dung	45	2 8	32670	583	
19	Hog's Ditto	34½	1 2	25047	447	
35	Sea-Fowl Do.	42	2 2	30492	544	
51	None	30½	2 2	22143	395	Very stiff black clay.
	Total	152				lbs. 152 × 181.5 equal to 27588lbs. per acre.
	Three Inches deep.					
4	Horse Dung	37	2 0	26862	479	
20	Hog's Ditto	32	2 4	23232	414	
36	Sea-Fowl Do	41	1 14	29766	531	
52	None	24	2 2	17424	311	
	Total	134				lbs. 134 × 181.5 equal to 24221lbs. per acre.

Class II.—Large Seed cut in pieces.

Twelve Inches deep.

Number.	MANURES.	Produce of 30 feet of rows.	Weight of the 6 largest.		Produce per acre in lbs.	Produce per acre in bushels 56lbs	REMARKS.
		lbs.	lbs.	oz.			
5	Horse Dung	50	3	2	36300	648	Very fine.
21	Hog's Ditto	28½	2	8	20691	369	
37	Sea-Fowl Do.	39	2	2	28314	505	
53	None	22	2	2	15972	285	
	Total	139½					lbs. 139½ × 181.5 equal to 25319lbs. per acre.
	Nine Inches deep.						
6	Horse Dung	45½	3	0	33033	589	
22	Hog's Ditto	33½	2	6	24321	434	
38	Sea-Fowl Do.	43	3	0	31218	557	
54	None	29½	1	6	21417	382	
	Total	151½					lbs. 151½ × 181.5 equal to 27497lbs. per acre
	Six Inches deep.						
7	Horse Dung	41½	4	2	29766	531	
23	Hog's Ditto	36½	2	2	26136	466	
39	Sea-Fowl Do.	45½	2	10	33033	589	
55	None.	31½	1	14	22809	408	
	Total	154					lbs. 154 × 181.5 equal to 27951lbs. per acre.
	Three Inches deep.						
8	Horse Dung	39½	3	0	28677	511	
24	Hog's Ditto	29	1	12	21054	375	
40	Sea-Fowl Do.	43	3	12	31218	557	
56	None	32	2	14	23232	414	
	Total	143½					lbs. 143½ × 181.5 equal to 26045lbs. per acre.

Class III.—Eyes of middle-sized Potatoes scooped out.

Twelve Inches deep.

Number.	MANURES.	Produce of 30 ft. of rows.	Weight of the 6 largest.	Produce per acre in lbs.	Produce per acre in bushels 56lbs	REMARKS.
		lbs.	lbs. oz.			
9	Horse Dung	37	3 4	26862	479	
25	Hog's Ditto	23	1 10	16698	298	
41	Sea-Fowl Do.	29½	3 10	21417	382	
57	None	12¼	2 2	9256	165	
	Total	102¼				lbs. 102½ × 181.5 equal to 18558lbs. per acre.
			Nine Inches deep.			
10	Horse Dung	37	3 4	26862	479	
26	Hog's Ditto	23	3 2	16698	298	
42	Sea-Fowl Do	29	2 12	21054	375	
58	None	16¼	2 6	11797	210	
	Total	105¼				lbs. 105¼ × 181.5 equal to 19102lbs. per acre.
			Six Inches deep.			
11	Horse Dung	43½	3 10	31581	563	Best sort.
27	Hog's Ditto	37½	3 14	27225	485	
43	Sea-Fowl Do.	44½	3 8	32307	576	
59	None	26	2 0	18876	337	
	Total	151½				lbs. 151½1 × 81.5 equal to 27497lbs. per acre.
			Three Inches deep.			
12	Horse Dung	29½	4 10	21417	382	
28	Hog's Ditto	37½	2 14	27225	485	Numerous small excrescences on the haulm.
44	Sea-Fowl Do.	35	2 14	25410	453	
60	None	26½	2 10	19239	343	
	Total	128½				lbs. 128½ × 181.5 equal to 23323lbs. per acre

Class IV.—Small Potatoes planted whole.

Number.	MANURES.	Produce of 30 ft. of rows.	Weight of the 6 largest.	Produce per acre in lbs.	Produce per acre in bushels 56lbs	REMARKS.
		Twelve Inches deep.				
		lbs.	lbs. oz.			
13	Horse Dung	31	1 12	22506	401	
29	Hog's Ditto	38½	1 6	27951	499	
45	Sea-Fowl Do.	38	1 0	27588	492	
61	None	28½	1 12	20691	369	
	Total	136				lbs. 136×181.5 equal to 24684lbs. per acre.
		Nine Inches deep.				
14	Horse Dung	39½	1 8	28677	512	
30	Hog's Ditto	40½	1 12	29403	525	
46	Sea-Fowl Do.	43	2 9	31218	557	
62	None	34	1 12	24684	440	
	Total	157				lbs. 157×181.5 equal to 28495lbs. per acre.
		Six Inches deep.				
15	Horse Dung	45	1 12	32670	583	
31	Hog's Ditto	42	1 10	30492	544	
47	Sea-Fowl Do.	48½	2 0	35211	628	Nearly a heaped bushel remarkably fine potatoes.
63	None.	44	2 6	31944	570	
	Total	179½				lbs. 179½×181.5 equal to 32579lbs. per acre.
		Three Inches deep.				
16	Horse Dung	32	1 12	23232	414	
32	Hog's Ditto	34	2 2	24684	440	
48	Sea-Fowl Do.	43	2 0	31218	557	
64	None	34	2 0	24684	440	
	Total	143				lbs. 143×181.5 equal to 25954lbs. per acre.

The following is an abstract from the preceding table, and is a comparative view of the effects of the several classes of seed, shewing the total produce in pounds.

		Pounds.
Class 1.	Seed the size of walnuts planted whole, yielded -	553½
2.	Large seed cut in pieces - - -	588½
3.	Eyes of middle-sized potatoes - - -	487½
4.	Small potatoes planted whole - - -	615½
	Total pounds	2245

These results will be pleasing to the planters—since they have clearly ascertained that small potatoes planted whole, which would not fetch so good a price in the market as the largest sort, are the best for seed.

The following is a comparative view of the effects of different depths of planting, showing the total produce in pounds.

			Pounds.
1st,	Six inches deep, yielded	-	637
2d,	Three ditto ditto	-	549
3d,	Nine ditto ditto	-	547¼
4th,	Twelve ditto ditto	-	511¾
	Total pounds		2245

By these results, it is proved, that planting at the depth of six inches on stiffish land is the most productive; but if the soil be of a lighter and freer sort, it is probable nine inches, or more, would yield best, because the moisture necessary for vegetation lays deeper in that sort than in a more retentive soil.

The following is a comparative view of the effects of the manures; showing the total produce in pounds.

		Pounds.
1st,	The Guana;* or, Sea-Fowl dung, at 35 bushels per acre, yielded	639
2d,	Horse dung litter, at 35 cart loads, or 420 bushels per acre, yielded	626
3d,	Hog's dung litter, at 35 cart loads, or 420 bushels per acre, yielded	534
4th,	No manure - - - - - -	446
	Total pounds	2245

* The Guana, or Sea-Fowl dung, which is found in considerable quantities upon Egg Island,

These results decisively prove the great advantage of manuring the lands, which would evidently repay the additional expense, and would maintain the potatoe

was first recommended to my notice by the Right Honourable Sir Joseph Banks, President of the Royal Society: "It furnishes," says he, "the loading of an immense number of vessels that are "constantly employed in bringing it from small islands to the main land on the western coast "of South America, where it is sold and distributed for the purpose of manure; which it answers, "in a degree, infinitely superior to any other article we have the knowledge of.—A handful is "considered as sufficient for several square yards of land, the produce of which is exuberant, in "consequence of the force of this application."

The accuracy of this valuable communication has been most amply confirmed by my experiments in the culture of Potatoes, as well as upon grass-lands. Thirty-five bushels of the Guana, or three cart-loads per acre, appear to me equivalent, in effect, to seventy loads of good rot dung. I should imagine that abundance of this most valuable manure might be had from many of the rocks and islands on the coasts of Scotland.

The effect of the Guana upon grass-land is comparatively greater than in the potatoe experiments.—From what cause this proceeds it may be difficult to explain: but as Dr. Priestley found, by experiment, that vegetables throve best when they were made to grow in air made putrid by the decomposition of animal and vegetable substances, it may be inferred that the very strong effluvia which issues from the Sea-Fowl dung, or Guana, together with its being readily washed among the roots of vegetables by the first falls of rain, are circumstances that may possibly render its effects, as a top dressing, greatly superior to those it produces when it is mixed with the soil. By this mixture its powers may be weakened, and a great portion of effluvia, which by some is supposed the proper food of plants, being retained underground, cannot escape and unite with the atmosphere.

On the 29th of July, 1808, I marked out a space, on the lawn in front of Plantation House, which measured one rod in breadth, and twelve rods in length. This was divided into twelve equal parts, or square rods, and numbered progressively from 1 to 12. The Guana was reduced to a powder, and sifted; and upon number I. a quart of this powder was evenly strewed by the hand; this is at the rate of five Winchester bushels per acre; because 160 square rods, or an acre, would have required that number of quarts, or exactly five bushels. In the same manner number II. had two quarts, number III. three quarts, and so on to number XII. which had twelve quarts, or at the rate of 60 bushels per acre.

From the 29th of July there were, daily, drizzling rains until the 5th of August, when the effect of this invaluable manure began to appear. On the following day the whole extent of the 12 rods became highly verdant, and exhibited such a contrast to the unmanured part of the lawn, that it had the appearance of having been newly turfed with a finer kind of sod. The effect gradually increased; and in the first week of October, that is, in little more than two months, the higher numbers, from 6 to 12, (having from 30 to 60 bushels per acre), excited the surprise of every person who saw them, being covered with the most exuberant grass that can be imagined,

grounds in good heart. These might, no doubt, be further improved by rotations of corn and green crops, which would prevent those disappointments that arise after perpetual croppings of potatoes for 12 or 14 years without manure. By such a practice, labour becomes useless, its expenses are thrown away; and the lands, originally productive, are, in the end, completely exhausted. This is a fact well known to the planters.

It has already been mentioned that the greatest produce was from experiment No. 5, which was large seed cut in pieces, planted 12 inches deep, and manured with horse dung litter. Thirty feet of the rows yielded 50 pounds of very fine potatoes, which is at the rate of 648 bushels per acre.

To those who are unaccustomed to such calculations, it may be proper to explain in what manner the results in the table are computed, from the length of 30 feet of rows.

An English statute acre consists of 10 square chains. This may be more readily comprehended by imagining a space, one chain in breadth, and ten in length. As a chain measures 66 feet, it is evident an acre of the above form will be 66

and having more the resemblance of a crop of young wheat, very thickly sown, than of any grass I ever beheld.

This is the more remarkable, as at that time, the copious rains which fell in August and the spring season had made no visible effect on the adjoining part of the lawn.

It was from a frequent and careful inspection of the above experiments that I have estimated 35 bushels of Guana per acre to be equivalent in effect, upon grass-lands, to 70 loads of good rot dung.

I have been informed that Guana is sold at Lima, and at other towns on the coast of Peru, for a dollar a bag, of 50 pounds weight, and that it is much in use there for manuring fruit-trees and gardens.

It is certainly one of the most powerful of manures; and therefore it is necessary to be cautious in using it. I have observed, when too much is laid upon grass, that it burns and destroys it.— I would therefore recommend, to those who may try it on fruit-trees, to begin with not more than three quarters of a pint to each tree, and to trench it, about a foot deep, all round the roots. If the first application be found insufficient, a second, or third, may be given at intervals of two or three months; or, a better mode, perhaps, of determining the quantity of Guana proper for each fruit-tree, would be to select about a dozen trees of the same kind and size, and to vary the quantities, by an easy progression, from three quarters of a pint, to one or two quarts, or more, to each tree.

ALEX. BEATSON.

feet broad, and 660 feet long, and consequently the contents of an acre are 43560 square feet.

If this acre be planted in rows, 2 feet asunder, there may be placed 33 rows in its breadth, and this number of rows, multiplied by 660 feet, will give 21780 feet for the total length of the rows. Then, if this sum be divided by 30 feet, it will be found that this length of rows is exactly the 726th part of an acre, consequently the produce in pounds, of any one of my experiments, multiplied by 726, will give the acreable produce in pounds. To find this produce in bushels, divide by 56 pounds, the weight of a St. Helena bushel.

For example, experiment No. 5, yielded 50 pounds; multiplying this by 726, gives 36300 pounds, and dividing by 56, gives 648 bushels, as entered in the table.

I was, however, accidentally led into this mode of computation, because, as I have already stated, the rows had been reduced from 16½ to 15 feet. The readiest way, of determining the acreable produce of a crop of potatoes, or of corn, is first to ascertain the quantity yielded from one rod (that is 16½ feet square), measured upon any part of the field, and then to multiply that quantity by 160 (which is the number of square rods in an acre), the product will be the computed quantity per acre.

ALEX. BEATSON.

St. Helena,
January 12*th*, 1811.

No. XXIX.

Remarks on the Culture of Mangel Wurzel, *in the Island of St. Helena. By Colonel* Alexander Beatson, *Governor, &c. &c.*

My attention was accidentally directed to the culture of *Mangel Wurzel*, which is the white or sugar-beet, lately so celebrated in Prussia, by observing the rapid vegetation of its leaves, and the frequent cuttings obtained from some plants that were set out on the 6th of February, from a seed-bed sown on the 3d of January, 1809; but it was not until the 21st of June following, that I resolved to try the effects of manures; and, accordingly, a portion of the transplanted Mangel Wurzel, being 130 plants, was left without manure—81 plants had a top-dressing of hog's dung and ashes, at the rate of about 30 loads, or 360 bushels per acre; and the remaining portion, containing 48 plants, was treated in the same manner with Guana, or sea-fowl dung, in the proportion of only 35 bushels per acre.

If I had predetermined to report on these experiments, I should have made them in a more regular form; that is, I should have allowed an equal number of plants to each; but under the circumstances which have led to them, the result shall be given, exactly as they were recorded at the periods of cutting the leaves, and when the experiments were completed.

The three first cuttings, not having at the time attracted my notice, were not weighed; I have therefore taken them in the following table, at the proportions of the fourth, fifth, and sixth cuttings, which is a fair presumption, as they are in general most productive in the early stages of their growth.

TABLE exhibiting the produce in leaves of 259 plants of Mangel Wurzel, at Plantation House Garden, from seed sown on the 3d January, transplanted on the 6th February, and manured on the 21st June, 1809.

Dates of Cuttings.	No Manure.	Hogs Dung.	Guana, or sea-fowl Dung.	
	130 Plants.	81 Plants.	48 Plants.	
1809.	lib. oz.	lib. oz.	lib. oz.	
February 24	37. 0	107. 0	106. 0	1st Cuttin } Estimated.
April 8	45. 0	123. 0	72. 0	2d Ditto
June 21	62. 0	117. 0	58. 0	3d Ditto
August 22	36. 8	107. 4	106. 6	4th Ditto
October 22	45. 0	123. 0	72. 0	5th Ditto
December 22	62. 0	117. 8	58. 8	6th Ditto
1810.				
March 23	38. 0	62. 0	37. 3	7th Ditto
May 23	81. 0	126. 0	114. 0	8th Ditto
July 24	29. 0	72. 0	37. 0	9th Ditto
September 22	36. 0	79. 0	65. 0	10th Ditto
November 22	36. 0	59. 0	32. 0	11th Ditto
	507. 8	1092. 12	758. 1	TOTALS.
	—167th	—269th	—454th	Proportions of an Acre.
	84752	293949	344160	Acreable produce in lbs.
	—38	—131	—153	Do.—in Tons.

The plants were placed in rows, two feet asunder, in a blackish stiff soil, and at the distance of one foot in the rows. An acre planted in this manner would contain 21780 plants; 48 plants are therefore very nearly (as entered in the Table) the 454th part of an acre—because $48 \times 454 = 21792$. In the same manner the other proportions are deduced.

Observing the produce in leaves had diminished at the last three cuttings, and that they had also been much infested with caterpillars since they began to decline, I had the roots taken up on the 17th January, 1811. From the 22d of November to that time, the growth of the leaves was inconsiderable; they were, however, cut off close to the crowns; and the whole, after being pruned of the small fibres, weighed 1196 pounds.

As the roots of the experiment lots were not separately weighed, I deduce their respective produce in the following manner:

As the total weight of the leaves,
Is to the total weight of the roots;
So is the weight of the leaves from each experiment,
To its proportion of the roots. Then,

lib.		lib.		lib.		lib.
2358	:	1196	::	507	:	257——no manure
2358	:	1196	::	1093	:	$554\frac{1}{2}$ Hogs dung and ashes
2358	:	1196	::	758	:	$384\frac{1}{2}$ Guana, or sea-fowl dung.

These results being reduced to acreable produce, in the same manner as the leaves in the preceding table, will be as follows:

No manure,—257 lib. × 167th = 42919 libs. or $19\frac{1}{4}$ tons of roots per acre.

Hogs dung and ashes,—$554\frac{1}{2}$lib. × 269th = 149160 libs. or $66\frac{1}{2}$ tons of roots per acre.

Guana, or sea-fowl dung—$384\frac{1}{2}$ lib. × 454th = 174563 libs. or $77\frac{3}{4}$ tons of roots per acre.

Now, the acreable produce in leaves and roots from each experiment will stand thus:

	Leaves. Acreable Produce.		Roots. Acreable Produce.		Total acreable produce of the leaves and roots.
No manure - - -	38 tons	+	$19\frac{1}{4}$ tons	=	$57\frac{1}{4}$ tons
Hogs dung and ashes -	131 ditto	+	$66\frac{1}{2}$ ditto	=	$197\frac{1}{2}$ ditto
Guana, or sea-fowl dung	$153\frac{1}{4}$ ditto	+	$77\frac{3}{4}$ ditto	=	231 ditto.

These results are manifest proofs of the great benefit of manuring the lands. They likewise show the surprizing effect of the Guana, from which it may be inferred that 35 *bushels* of this manure are superior to 30 *loads* of hogs dung and ashes; or, in other words, that one bushel of the former is, in effect, superior to twelve bushels of the latter.

When the roots were taken up, on the 17th of January last, very few of them were in a decayed state; some had rotted in the centre; but, in general, they were sound and good, notwithstanding they had remained above two years in the soil; that is, from the period of sowing the seed. The four largest roots weighed as follows:

No. 1. - - - -	28 pounds
2. - - -	11 ditto
3. - - -	19 ditto
4. - - -	20 ditto

Having thus detailed these experiments, I shall now proceed to offer a few remarks, which will show the important benefits that might soon be derived from a general, and extentive culture of this excellent vegetable.

It certainly possesses advantages over every other plant hitherto introduced in field culture.—Its produce is immense, and I have found it to grow, with considerable luxuriance, upon land where no other vegetation was ever seen.* It has also the singular property of being unmolested by an insect (I believe the dolphin fly) which is here extremely destructive to cabbages, turnips, and radishes. I have very often observed where alternate plants of cabbage and Mangel Wurzel were growing in the same rows, and touching each other, that whilst the former were absolutely annihilated by that destructive insect, not one was to be seen on the Mangel Wurzel leaves.

The Mangel Wurzel, when fairly established in the soil (which, like every other crop upon an extensive scale, ought to be just before the expected rains in January and February, or in July and August), will soon acquire such vigour as to become almost independent of rain: for having a tap root, penetrating 12 to 18 inches, or more, into the soil, it will always find sufficient moisture at that depth for carrying on the process of vegetation. In the course of five or six months, from the seed, if sown or planted in good soil, three cuttings of the leaves may be obtained, which may average about three pounds from each plant; and the roots will then have attained weight of five to ten pounds each. Wherefore it seems to me, after every attention I have given this subject, that the most profitable culture would be to take

* This was determined by an experiment I made soon after my arrival here. I selected a barren ridge, between two deep ravines, on the north-west side of High Knoll. From its situation and declining surface, no moisture could be retained. On the 27th August, 1808, it was trenched, and on the following day sown with sixteen different sorts of seeds, so that it had not the advantage of the meliorating effects that might have been derived from exposure to the air and atmosphere. For a long time there was no appearance of vegetation; at length, in the beginning of April, 1809, seven months after sowing, and when it had been soaked by the rains, I observed the drill of Mangel Wurzel one connected line of fine thriving plants: the fifteen rows of other seeds, excepting a few of the rape, had not vegetated. This is a positive proof that Mangel Wurzel would grow in almost any soil or situation. The seeds which were sown at the same time as the Mangel Wurzel, were Coffee, Cotton, Wheat, Barley, Oats, Pease, Buck Wheat, Spring Tares, Lucern, Burnet, Sanfoin, Silla, Chicory, Rape, and Sunflower. Not a plant of any of these, except the Rape, which soon after died, ever appeared.

three cuttings of the leaves, and at the third cutting, to dig up the roots:—these, as well as the leaves, afford a nutritious food for cattle, sheep, hogs. &c. The leaves are also an excellent substitute for spinage.

It is very probable that a more abundant produce from Mangel Wurzel than appears in my experiments, might at all times be secured, if the lands were manured and carefully prepared for its reception, and the proper seasons of sowing and planting attended to. In a piece of strong land at Plantation House, newly broken up, without being manured, some of the plants from seed sown on the 3rd of January, were set out on the 6th of February, 1809. On the 11th of October following, I sent on board his Majesty's ship Lion, fifty of those plants, which were the finest I had ever seen. The following were the weights and circumferences of the five largest.

	Weight of the whole Plant.		Circumference of the Roots.	
	lb.	oz.	ft.	in.
No. 1. -	41	3	2	1
2. -	39	1	1	9
3. -	39	6	1	10
4. -	38	0	2	0
5. -	37	14	1	11

At Longwood, Colonel Broughton has lately taken up some very fine specimens from land that was not manured: they were of six months growth from the seed—the leaves had been cut twice. Many of the roots weighed from six to ten pounds each: but admitting even the lowest of these rates, and allowing one pound of leaves at each cutting, the produce would be eight pounds from each plant; which, at 20,000 plants to an acre, would be 160,000 pounds, or about 70 tons per acre, of nutritious food for cattle, in the short period of five or six months from the time of sowing the seed. Can any thing place the importance of the culture of Mangel Wurzel in a more obvious point of view than this deduction?

But the largest plant that has yet been produced here, is one I sent to England, with several others, in July, 1810. It was raised from seed, put in the ground on the 3rd of March, and transplanted to land newly broken up, on the 1st of May, 1809; when it was taken up in July (that is, at sixteen months from the period of sowing) the circumference of the crown of the root measured 37 inches. It had about twenty strong horizontal branches, two or three inches in diameter; the

leaves and small ends of those brances were cut off, and weighed 52 pounds. The root and remaining parts of the branches on it, in the state it was sent to England, weighed 63 pounds. In all, the weight of this one plant, from unmanured land, was 115 pounds. I have been since informed it was by far the largest of the kind ever seen in England.

ALEX. BEATSON.

St. Helena, 15th October, 1811.

Note. The Board of Agriculture cannot admit that any accuracy attends the method pursued by Governor Beatson in ascertaining the acreable products of the crops here noted; nor is it at all essential that Mangel Wurzel should yield so immensely as it is stated to have done in these trials; it is sufficiently clear, that the produce is very great, probably exceeding that of any other root. The great effect of Guana manure is an object particularly deserving attention.

No. XXX.

An Account of the Cultivation, Expense, and Produce of Waste Land in the Parish of Helmsley, *in the Occupation of* Charles Duncombe, *Esq.*

To the Board of Agriculture.

THE favourable sentiments which the Board was pleased to entertain of the communication I submitted to it in March 1810, induces me again to offer for its consideration, a statement of different parcels of land, which by different means have been reclaimed from a state of waste. The deficiency of grain has been so considerable within these late years, that too much encouragement can scarcely be given to produce an increase of the necessaries of life, and it has for some years been an object with me to promote such a measure, by offering annually premiums to the inhabitants of two extensive parishes for that purpose, by reclaiming waste ground, as well as by making efforts of my own.

The different portions of ground herein submitted for the opinion of the Board, come, it is presumed, within its intended purpose in its offer of a premium for the reclaiming of waste land; and the whole quantity is exclusive of what I had the honour to lay before it on a former occasion.

I have the honour to be, &c. &c. &c.

24, *Arlington-street,*
March 2, 1812.

C. DUNCOMBE.

Previous to being broken up, the surface was covered with ling, and on some of the best parts brackens intermixed.

No. I. contains 7 acres, 25 perches.

How cultivated.	Expense.	L.	s.	d.	Produce.
1806.	1806.				
Pared and burnt, twice ploughed and twice harrowed, and sown with rye,	Paring and burning at 1*l.* 10*s* per acre	10	14	8	
	Twice ploughing and twice harrowing, at 12*s.* per acre - -	8	11	8	
	16 Bushels of seed rye, at 5*s.* 9*d.* per bushel - - -	4	12	0	
	To fencing 56 roods with posts, rails, and quickwood, at 5*s.* 9*d.* per rood	16	2	0	
	Gates and incidental expenses -	1	3	0	
		*L.*41	3	4	

No I. continued.

How cultivated.	Expense.	L.	s.	d.	Produce.
	1807.				1807. About 14 bushels of rye per acre; 7 .. 0 .. 25 = 100 bushels, at 6*s*. 3*d*. per bushel = 31*l*. 5*s*.
	Corn reaping, carrying, stacking, &c. at 16*s*. per acre	5	14	6	
	Thrashing 12½ quarters of rye, at 5*s*. per quarter	3	2	6	
		L.8	17	0	
1808. Three times ploughed and three times harrowed, limed, manured, and sown with turnips, which were eaten on the ground with sheep.	1808.	L.	s.	d.	1808. Turnips worth 4*l*. per acre. 7 .. 0 .. 25 at 4*l*. per acre = 28*l*. 12*s*. 6*d*.
	Three times ploughing and three times harrowing, at 12*s*. per acre	12	17	6	
	21 Chaldron of lime and leading, at 15*s*. per chaldron	15	15	0	
	Spreading ditto, at 9*d*. per chaldron	0	15	9	
	Leading and spreading 40 load of manure, at 1*s*. 3*d*.	2	10	0	
	Turnip seed and sowing	0	14	0	
	Turnips hoeing, at 7*s*. per acre	2	10	0	
		L.35	2	3	
1809. Once ploughed and once harrowed, and sown with oats and seeds, viz. 10lb. of white clover, 2lb. of trefoil, 2lb. of rib-grass, 2lb. of red clover, and 3 pecks of rye grass per acre.	1809.	L.	s.	d	1809. About 52 bushels of oats per acre. 7 .. 0 .. 25 = 368 bushels, at 3*s*. 9*d*. per bushel, = 69*l*.
	Once ploughing and once harrowing, at 12*s*. per acre	4	5	10	
	34 Bushels of seed oats, at 4*s*. 6*d*. per bushel	7	13	0	
	Corn reaping, carrying, stacking, &c. at 1*l*. per acre	7	3	1	
	Thrashing 46 quarters of oats, at 1*s*. 2*d*. per quarter	2	13	8	
	Seeds 1*l*. 1*s*. per acre	7	10	0	
		L.29	5	7	
1810. Pastured with mixed stock.					1810. An adjoining field of old enclosure was laid open to No. I. therefore it cannot be ascertained what stock was depastured upon it,
1811. Mown.	1811.	L.	s.	d	1811. About 1½ ton of hay per acre. 7 .. 0 .. 25 = 10⅝ tons, at 3*l*. 10*s*. per ton = L.36 15
	Mowing, haymaking, carrying, stacking, &c. at 14*s*. per acre	5	0	0	7 .. 0 .. 25 of fog, at 15*s* per acre 5 7
					Total value L. 42 2

Now worth 18*s*. per acre.

No. II. contains 7 acres, 1 rood, 15 perches.

How cultivated.	Expense.	L.	s.	d.	Produce.
1806.	1806.	L.	s.	d.	
Pared and burnt, twice ploughed, and twice harrowed, and on about 4 acres 2 roods laid 13 chaldrons of lime, which made the crop a great deal superior to the part that was not limed. 4 acres sown with rye, the remainder with bear barley.	Paring and burning, at 1*l*. 10*s*. per acre	11	0	3	
	Twice ploughing and twice harrowing, at 12*s*. per acre - -	8	16	2	
	13 Chaldrons of Lime and leading, at 15*s*. per chaldron - - -	9	15	0	
	Spreading do. at 9*d*. per chaldron -	0	9	9	
	9 Bushels of seed rye, at 5*s*. 9*d*. per bushel - - -	2	11	9	
	8 Do. of seed barley, a 5*s*. do. -	2	0	0	
	To fencing 83½ roods, with posts, rails, and quickwood, at 5*s*. 9*d*. per rood - -	24	0	0	
	Gates and incidental expenses -	1	3	0	
		L.59	15	11	
	1807.	L.	s.	d.	1807.
	Corn reaping, carrying, stacking, &c. at 1*l*. per acre - - - -	7	6	10	About 28 bushels of rye per acre; 4 acres=112 bushel, at 6*s*. 3*d*. per bushel= - L.35 0 About 16 bushels of bear barley per acre. 3 .. 1 .. 15 = 52 bushels, at 4*s*. 6*d*. per bush. 11 14
	Thrashing 20½ quarters of rye and bear barley, at 4*s*. per quarter	4	2	0	
		L.11	8	10	Total value L.46 14
1808.	1808.				1808.
Three times ploughed and three times harrowed, limed, and sown with turnips, which were eaten on the ground with sheep.	Three times ploughing, and three times harrowing, at 12*s*. per acre	13	4	3	Turnips worth 4*l*. per acre. 7 .. 1 .. 15 at 4*l*. per acre=29*l*. 7*s*. 6*d*.
	22 Chaldrons of lime and leading, at 15*s*. per chaldron - -	16	10	0	
	Spreading do. at 9*d*. per chaldron -	0	16	6	
	Turnip seed and sowing - -	0	14	6	
	Turnips hoeing, at 7*s*. per acre	2	11	4	
		L.33	16	7	
1809.	1809.	L.	s.	d.	1809.
Once ploughed and once harrowed, and sown with oats and seeds. The same quantity of seeds per acre as in No. I.	Once ploughing and once harrowing, at 12*s*. per acre - - -	4	8	1	About 52 bushels of oats per acre. 7 .. 1 .. 15= 380 bushels, at 3*s*. 9*d*. per bushel=71*l*. 5..
	35 Bushels of seed oats, at 4*s*. 6*d*. per bushel - - - - -	7	17	6	
	Corn reaping, carrying, stacking, &c. at 1*l*. per acre - -	7	6	10	
	Thrashing 47½ quarters of oats, at 1*s*. 2*d*. per quarter - -	2	15	5	
	Seeds, 1*l*. 1*s*. per acre - -	7	13	0	
		L.30	0	10	

No. II. continued.

How cultivated.	Expense.	Produce.
1810. Mown.	1810. L. s. d. Mowing, haymaking, carrying, stacking, &c. at 14s. per acre - 5 2 9	1810. About 2 ton of hay per acre. 7 .. 1 .. 15=14⅝ tons, at 3l. 10s. per ton= L.50 15 0; 7 .. 1 .. 15 of fog, at 1l. 10s. per acre - 11 0 3; Total value L. 61 15 3
1811. Pastured with mixed stock.		1811. An adjoining field of old enclosure was laid open to No. II. therefore it cannot be ascertained what stock was depastured upon it.

Now worth 20s. per acre.

No. III. contains 5 acres.

How cultivated.	Expense.	Produce.
1806. Pared and burnt, twice ploughed and twice harrowed, and limed. 3 acres sown with bear-barley, and 2 acres sown with rye.	1806. L. s. d Paring and burning, at 1l 10s. per acre 7 10 0 Twice ploughing and twice harrowing, at 12s. per acre - - 6 0 0 15 Chaldrons of lime and leading, at 15s. per chaldron - - 11 5 0 Spreading do. at 9d. per chaldron 0 11 3 7 Bushels of bear barley, at 5s. per bushel - - - 1 15 0 4¼ Do. of rye, at 5s 9d. per bushel 1 4 10 To fencing 51 roods with posts, rails, and quickwood, at 5s. 9d. per rood 14 13 3 Gates and incidental expenses - 1 3 0 L.44 2 4	
	1807. Corn reaping, carrying, stacking, &c. at 19s. per acre - - 4 15 0 Thrashing 11 quarters of rye and barley, at 4s. per quarter - 2 4 0 L.6 19 0	1807. About 20 bushels of rye per acre. 2a.=40 bushels, at 6s. 3d. per bushel= L.12 10 About 16 bushels of barley per acre. 3a.=48 bushels, at 4s. 6d. per bus. 10 16 Total value 23 6

No. III. continued.

How cultivated.	Expense.	L.	s.	d.	Produce.
1808. Three times ploughed and three times harrowed, limed, manured, and sown with turnips, which were eaten on the ground with sheep.	1808.				1808. Turnips worth 3*l.* 18*s.* per acre. 5 acres, at 3*l.* 18*s.* per acre=19*l.* 10*s.*
	Three times ploughing and three times harrowing, at 12*s.* per acre	9	0	0	
	15 Chaldrons of lime and leading, at 15*s.* per chaldron - -	11	5	0	
	Spreading ditto, at 9*d.* per chaldron	0	11	3	
	Leading and spreading 53 load of manure, at 1*s.* per load - -	2	13	0	
	Turnip seed and sowing - -	0	10	0	
	Turnips hoeing, at 7*s.* per acre -	1	15	0	
		L.25	14	3	
1809. Once ploughed and once harrowed, and sown with bear barley.	1809.				1809. About 35 bushels of bear barley per acre. 5 acres =175 bushels, at 6*s.* per bushel=52*l.* 10*s.*
	Once ploughing and once harrowing, at 12*s.* per acre - -	3	0	0	
	12 Bushels of bear barley, at 7*s.* per bushel - - -	4	4	0	
	Corn reaping, carrying, stacking, &c. at 1*l.* per acre - -	5	0	0	
	Thrashing 21½ quarters of bear barley, at 3*s.* per quarter - -	3	4	6	
		L 15	8	6	
1810. Three times ploughed and three times harrowed, manured, and planted with potatoes.	1810.				1810. About 210 bushels of potatoes per acre. 5 acres=1050 bushels, at 2*s.* per bushel=105*l.*
	Three times ploughing and three times harrowing, at 10*s.* per acre -	7	10	0	
	70 Load of manure and leading, at 10*s.* per load - -	35	0	0	
	70 Bushels of potatoe-sets, at 2*s.* 6*d.* per bushel - - -	8	15	0	
	Planting potatoes, &c. at 4*s.* per acre	1	0	0	
	Hand-weeding do. at 2*s.* per acre	0	10	0	
	Potatoes taking up, carting, &c. at 2*l.* 8*s.* per acre - -	12	0	0	
		L.64	15	0	
1811. Twice ploughed and twice harrowed, sown with rape and seeds. The same quantity of seeds per acre as in No. I.	1811.				1811. Pastured with sheep, eatage worth 2*l.* per acre, 5 acres, at 2*l.* per acre= 10*l.*
	Two times ploughing and two times harrowing, at 10*s.* per acre. -	5	0	0	
	2½ Pecks of rape seed, at 4*s.* 6*d.* per peck - - - -	0	11	3	
	Seeds, 1*l.* 2*s.* per acre - -	5	10	0	
		L.11	1	3	

Now worth 18*s.* per acre.

No. IV. contains 4 acres, 1 rood.

How cultivated.	Expense.	L.	s.	d.	Produce.
1809. Pared and burnt, once ploughed and harrowed.	1809. Paring and burning at 1*l.* 10*s.* per acre	6	7	6	
	Once ploughing and once harrowing at 15*s.* per acre - - -	3	3	9	
	To fencing 50 roods with posts, rails, and quickwood at 5*s.* 9*d.* per rood	14	7	6	
	Gates and incidental expenses -	1	3	0	
	L	25	1	9	
1810. Three times ploughed, and three times harrowed, limed, manured, and planted with potatoes.	1810. Three times ploughing and three times harrowing at 10*s.* per acre -	6	7	6	1810. About 120 bushels of potatoes per acre. 4.. 1 .. 0 =510 bushels at 2*s.* per bushel=51*l.*
	16 chaldrons of lime and leading at 15*s.* per chaldron - -	12	0	0	
	Spreading do. at 9*d.* per chaldron -	0	12	0	
	60 loads of manure and leading at 10*s.* per load - - - -	30	0	0	
	60 bushels of potatoe sets at 2*s.* 6*d.* per bushel - - -	7	10	0	
	Planting potatoes at 4*s.* per acre -	0	17	0	
	Hand weeding do. at 2*s.* do. -	0	8	6	
	Potatoes taking up, carting, &c. at 2*l.* per acre - - - -	8	10	0	
	L.	66	5	0	
1811. Twice ploughed, and twice harrowed, and sown with rape and seeds. The same quantity of seeds per acre as in No I.	1811. Two times ploughing and two times harrowing at 10*s.* per acre -	4	5	0	1811. Pastured with sheep. Eatage worth 1*l.* 16*s.* per acre. 4 .. 1 .. 0 at 1*l.* 16*s.* per acre=7*l.* 13*s.*
	2¼ pecks of rape seed at 4*s.* 6*d.* per peck	0	10	1	
	Seeds 1*l.* 2*s.* per acre - -	4	13	6	
	L	9	8	7	

Now worth 11*s.* per acre.

No. V. contains 10 acres, 20 perches.

How cultivated.	Expense.	L.	s.	d.	Produce.
1809. Pared and burnt, once ploughed, and once harrowed, limed, and sown with rye.	1809. Paring and burning at 1*l.* 11*s.* per acre	15	13	10	
	Once ploughing and once harrowing at 16*s.* per acre - - -	8	10	0	
	22 chaldrons of lime and leading at 15*s.* per chaldron - - -	16	10	0	
	Spreading do. at 9*d.* per chaldron	0	16	6	
	24 bushels of seed rye at 7*s* 6*d.* per bushel - - -	9	0	0	
	To fencing 68 roods with posts, rails, and quickwood, at 5*s.* 9*d.* per rood	19	11	0	
	L.	70	1	4	

No. V. continued.

How cultivated.	Expense	L.	s.	d.	Produce.
	1810.	L.	s.	d	1810.
	Corn reaping, carrying, stacking, &c. at 10s. per acre - -	5	1	3	About 3½ bushels of rye per acre. 10 .. 0 .. 20 = 36 bushels at 7s. per bushel = 12l. 12s.
	Thrashing 4½ quarters of rye at 5s. per acre - - -	1	2	6	
		L.6	3	9	
1811.	1811.	L.	s.	d.	1811.
Three times ploughed, and three times harrowed, limed, manured, and planted with potatoes.	Three times ploughing, and three times harrowing at 10s. per acre	15	3	9	About 196 bus. of potatoes per acre. 10 .. 0 .. 20 = 1984 bushels, at 2s. per bushel = 198l. 8s.
	38 chaldrons of lime and leading at 15s. per chaldron - -	28	10	0	
	Spreading do. at 9d per chaldron	1	8	6	
	140 load of manure and leading at 10s. per load - - -	70	0	0	
	142 bushels of potatoe sets at 2s. 6d. per bushel - -	17	15	0	
	Planting potatoes at 4s. per acre	2	0	0	
	Hand-weeding do. at 2s. per acre	1	0	0	
	Potatoes taking up, carting, &c. at 2l. per acre - - -	20	5	0	
		L.156	2	3	

Now worth 14s. per acre.

No. VI. contains 5 acres, 3 roods, 30 perches.

How cultivated.	Expense.	L.	s.	d.	Produce.
1809.	1809.	L.	s.	d.	
Pared and burnt.	Paring and burning a 1l. 11s. per acre	9	4	0	
1810.	1810.	L.	s.	d	1810.
Twice ploughed and twice harrowed, limed, and sown with rape, which was eaten with sheep.	Two times ploughing and two times harrowing at 13s. per acre -	7	14	4	Rape worth 6s. per acre. 5a. 3r. 30p. at 6s. per acre = 1l. 15s. d.
	19 chaldrons of lime and leading at 15s. per chaldron -	14	5	0	
	Spreading do. at 9d per chaldron	0	14	3	
	3 pecks of rape seed at 4s. 6d. per peck	0	13	6	
	To fencing 80 roods with posts, rails, and quickwood at 5s. 9d. per rood	23	0	0	
		L 46	7	1	

No. VI. continued.

How cultivated.	Expense.	*L.*	*s.*	*d.*	Produce.
1811.	1811.				1811.
Twice ploughed, and twice harrowed, and sown with bear barley.	Two times ploughing and two times harrowing at 12*s.* per acre -	7	2	6	About 32 bushels of bear barley per acre. 5 .. 3 .. 30=188 bushels at 6*s.* 3*d.* per bushel = 58*l.* 15*s.*
	13½ bushels of bear barley at 6*s.* per bushel - - -	4	1	0	
	Corn reaping, carrying, stacking, &c. at 18*s* per acre - -	5	6	10	
	Thrashing 23½ quarters of bear barley at 3*s.* 6*d.* per quarter -	4	1	3	
		*L.*20	11	7	

Now worth 16*s.* per acre.

No. VII. contains 6 acres, 30 perches.

How cultivated.	Expense.	*L.*	*s.*	*d.*	Produce.
1810.	1810.				
Pared and burnt, three times ploughed, and three times harrowed, limed, and sown with rye.	Paring and burning at 1*l.* 11*s.* per acre	9	11	9	
	Three times ploughing and three times harrowing at 13*s.* per acre	12	1	3	
	21 chaldrons of lime and leading at 15*s.* per chaldron -	15	15	0	
	Spreading do. at 9*d.* per chaldron	0	15	9	
	13½ bushels of seed rye at 7*s.* 6*d.* per bushel - - -	5	1	3	
	To fencing 110 roods with posts, rails, and quickwood at 5*s.* 9*d.* per rood - - -	31	12	6	
		*L.*74	17	6	
	1811.	*L.*	*s*	*d*	1811.
	Corn reaping, carrying, stacking, &c. at 1*l.* per acre - -	6	3	9	About 28 bushels of rye per acre. 6 .. 0 .. 30 = 172 bushels at 6*s.* 6*d.* per bushel=55*l.* 18*s.*
	Thrashing 21½ quarters of rye at 4*s.* per quarter - -	4	6	0	
		*L.*10	9	9	

Now worth 14*s.* per acre.

No.VIII. contains 12 acres, 20 perches.

How cultivated.	Expenses.	L.	s.	d.	Produce.
1810.	1810.	L.	s.	d.	1810.
Pared and burnt, three times ploughed and three times harrowed, limed, and sown with rye.	Paring and burning, at 1*l*. 11*s* per acre	18	15	10	The produce not yet thrashed out.
	Three times ploughing and three times harrowing, at 14*s*. per acre -	25	6	3	
	48 Chaldrons of lime and leading, at 15*s*. per chaldron - -	36	0	0	
	Spreading do. at 9*d*. per chaldron	1	16	0	
	26½ Bushels of seed rye, at 7*s*. 6*d*. per bushel - -	9	18	9	
	To fencing 88 roods with posts, rails, and quickwood, at 5*s*. 9*d*. per rood	25	6	0	
		L.117	2	10	
	1811.	£.	s.	d	1811.
	Corn reaping, carrying, stacking, &c. at 19*s*. per acre - - -	11	10	4	About 22 bushels of rye per acre. 12 .. 0 .. 20 =264 bushels, at 6*s*. 6*d*. per bushel=85*l*. 16*s*.
	Thrashing 33 quarters of rye, at 4*s*. per quarter - .	6	12	0	
		L.18	2	4	

Now worth 12*s*. per acre.

We do hereby certify that the foregoing Numbers have been improved, and are now of the value herein stated.

JOHN FISHER.

DANIEL RICHARDSON, Sen.

	a.	r.	p.
No. 1. Contains - -	7	0	25
2. Do. - - -	7	1	15
3. Do. - - -	5	0	0
4. Do. - -	4	1	0
5. Do. - -	10	0	20
6. Do. - -	5	3	30
7. Do. - -	6	0	30
8. Do. - -	12	0	20
	58	2	20

An Account of the Cultivation, Expense, and Produce of Waste Land in the Parish of Helmsley, belonging to Charles Duncombe, *Esq. and in the occupation of Mr.* John Bowes Carlton.

Previous to being broken up, the surface was covered with ling, and on some of the best parts brackens intermixed.

No. I. contains 4 acres.

How cultivated.	Expense.	L.	s.	d.	Produce.
1804. Pared and burnt, once ploughed and once harrowed and limed, 3 acres sown with rye.	1804. Paring and burning, a 1*l.* 10*s.* per acre Once ploughing, and once harrowing, at 13s. per acre - - 12 Chaldrons of lime and leading, at 15*s.* per chaldron - - Spreading do. at 9*d.* per chaldron 7½ Bushels of seed rye, at 6*s.* per bushel To 58 roods of fencing with a hedge and quickwood, at 4*s.* 6*d.* per rood Gates and incidental expenses -	6 2 9 0 2 13 1 *L.*34	0 12 0 9 5 1 3 10	0 0 0 0 0 0 0 0	
1805. One acre once ploughed and once harrowed, and sown with bear barley.	1805. One acre once ploughing and once harrowing . . . Seed barley . . . Corn reaping, carrying, stacking, &c. 1*l.* 2*s.* per acre . . Thrashing 13 quarters of rye and barley, at 4*s.* per quarter . .	0 0 4 2 *L.*8	10 16 8 12 6	0 0 0 0 0	1805. About 30 bushels of rye per acre. 3 acres=90 bushels, at 7*s.* per bushel =*L* 31 10 14 bush of barley, at 6*s.* per bushel 4 4 Total value *L.*35 14
1806. Three times ploughed and three times harrowed, limed, and sown with turnips, which were eaten on the ground with sheep.	1806. Three times ploughing and three times harrowing, at 12*s.* per acre . 14 Chaldrons of lime and leading, at 15*s.* per chaldron . . Spreading do. at 9*d* per chaldron Turnip seed and sowing . . Turnips hoeing, at 7*s.* per acre .	7 10 0 0 1 *L.*20	4 10 10 8 8 0	0 0 6 0 0 6	1806. Turnips worth 3*l.* per acre. 4 acres, at 3*l.* per acre=12*l.*

No. I. continued.

How cultivated.	Expense.	L.	s.	d.	Produce.
1807.	1807.	L.	s.	d.	1807.
Once ploughed and once harrowed; one acre sown with bear barley, and three acres sown with oats.	Once ploughing and once harrowing, at 12s per acre . .	2	8	0	About 40 bushels of oats per acre. 3 acres = 120 bushels, at 3s. 9d. per bushel = L.22 10
	2¼ bushels of bear barley, at 6s. per bushel	0	15	0	32 bushels of bear barley, at 4s. 6d. per bushel . 7 4
	15 Do. of seed oats, at 4s. per bushel	3	0	0	Total value L.29 14
	Corn reaping, carrying, stacking, &c. at 1l. 2s. per acre . . .	4	8	0	
	Thrashing 15 quarters of oats, at 1s. 2d. per quarter . .	0	17	6	
	Do. 4 quarters of bear barley, at 3s. 6d. per quarter . .	0	14	0	
		L.12	2	6	
1808.	1808.	L.	s.	d.	1808.
Three times ploughed and three times harrowed, limed, and sown with turnips, which were eaten on the ground with sheep.	Three times ploughing and three times harrowing, at 10s. per acre -	6	0	0	Turnips worth 3l. 10s. per acre. 4 acres, at 3l. 10s. per acre = 14l.
	12 Chaldrons of lime and leading, at 15s. per chaldron	9	0	0	
	Spreading ditto, at 9d. per chaldron	0	9	0	
	Turnip seed and sowing . .	0	8	0	
	Turnips hoeing, at 7s. per acre .	1	8	0	
		L.17	5	0	
1809.	1809.	L.	s.	d.	1809.
Once ploughed and once harrowed, and sown with oats and seeds, viz. 21lb. of white clover, and one bushel of rye-grass per acre.	Once ploughing and once harrowing, at 12s. per acre . . .	2	8	0	About 40 bushels of oats per acre. 4 acres = 160 bushels, at 3s. 9d. per bushel = 30l.
	19 bushels of seed oats, at 4s. 6d. per bushel	4	5	6	
	Seeds, 1l. 10s. per acre . .	6	0	0	
	Corn reaping, carrying, stacking, &c. at 1l. 2s. per acre . .	4	8	0	
	Thrashing 20 quarters of oats, at 1s. 2d. per quarter . .	1	3	4	
	Carrying stones off the land .	0	15	0	
		L.18	19	10	
1810. Pastured with mixed stock.					
1811.	1811.	L.	s.	d.	1811.
Mown.	Mowing, haymaking, leading, and stacking, at 14s. per acre .	2	16	0	About 1½ ton of hay per acre, 4 a. = 6 ton, at 3l. 10s per ton = L.21 0
					4 a. of fog, at 15s. per acre . 3 0
					Total value L.24 0

Now worth 15s. pr acre.

No. II. contains 4 acres, 3 roods.

How cultivated.	Expense	L.	s.	d.	Produce.
1806. Pared and burnt, once ploughed and once harrowed and sown with bear barley.	1806.				1806. About 12 bushels of barley per acre. 4a. 3r. =57 bushels, at 6s. per bushel=17l. 2s.
	Paring and burning at 1l. 10s. per acre	7	2	6	
	Once ploughing and once harrowing at 14s. per acre	3	6	6	
	11 bushels of bear barley at 5s. per bushel	2	15	0	
	Corn reaping, carrying, stacking, &c. at 14s. per acre	3	6	6	
	Thrashing 7 quarters of barley at 4s. 6d. per quarter	1	11	6	
	To fencing 43 roods with posts and rails, at 5s. per rood	10	15	0	
	Gates and incidental expenses	1	3	0	
		L 30	0	0	
1807. Three times ploughed, and three times harrowed, limed, and sown with turnips, which were eaten on the ground with sheep.	1807.				1807. Turnips worth 2l. 15s. per acre. 4a. 3r. at 2l. 15s. per acre=13l. 1s. 3d.
	Three times ploughing, and three times harrowing, at 10s. per acre	7	2	6	
	20 chaldrons of lime and leading, at 15s. per chaldron	15	0	0	
	Spreading do. at 9d. per chaldron	0	15	0	
	Turnip seed, and sowing	0	9	6	
	Turnips hoeing, at 7s. per acre	1	13	3	
		L 25	0	3	
1808. Once ploughed, and once harrowed, and sown with oats and seeds, (viz.) 14lb. of red clover, and 2 bushels of rye-grass per acre.	1808.				1808. About 44 bushels of oats per acre. 4a. 3r.=208 bushels, at 4s. 3d.= 44l. 4s.
	Once ploughing, and once harrowing, at 10s. per acre	2	7	6	
	20 bushels of seed oats, at 4s. 6d. per bushel	4	10	0	
	Seeds, 1l. per acre	4	15	0	
	Corn reaping, carrying, stacking, &c. at 1l. 2s. per acre	5	4	6	
	Thrashing 26 quarters of oats, at 1s. 2d. per quarter	1	10	4	
	Carrying stones off the land	0	16	0	
	To making a lime-kiln	10	0	0	
		L.29	3	4	
1809 Pastured with sheep and small beasts					
1810. Mown.	1810.				1810. About 1¼ ton of hay per acre. 4a. 3r.=6 tons at 3l. 10s. per ton= L.21 0 0
	Mowing, haymaking, leading, and stacking, at 13s. per acre	3	1	9	4a. 3r. of fog, at 15s. per acre 3 11 3
					Total value L.24 11 3

No. II. continued.

How cultivated.	Expense.	L. s. d.	Produce.
1811. Once ploughed, and once harrowed, and sown with oats.	1811. Once ploughing, and once harrowing, at 12*s.* per acre . .	2 17 0	1811 About 48 bushels of oats per acre. 4 a. 3 r. = 228 bushels, at 3*s.* 9*d* per bushel = 42*l.* 15*s.*
	20 bushels of seed oats, at 4*s.* per bushel	4 0 0	
	Corn reaping, carrying, stacking, &c. at 1*l.* 2*s.* per acre . .	5 4 6	
	Thrashing 28½ quarters of oats, at 1*s.* 2*d.* per quarter . .	1 13 3	
		L.13 14 9	

Now worth 14*s.* per acre.

No. III. contains 9 acres.

How cultivated.	Expense.	L. s. d.	Produce.
1806. Pared and burnt, once ploughed, and once harrowed, limed, 2 a. sown with rye.	1806. Paring and burning at 1*l.* 12*s.* per acre	14 8 0	
	Once ploughing, and once harrowing, at 13*s.* per acre . .	5 17 0	
	36 chaldrons of lime and leading, at 15*s.* per chaldron . .	27 0 0	
	Spreading do. at 9*d.* per chaldron	1 7 0	
	5 bushels of seed rye, at 5*s.* 9*d.* per bushel	1 8 9	
	To fencing 50 roods with posts, rails, and quickwood, at 5*s.* 9*d.* per rood	14 7 6	
	To making a pond . .	10 0 0	
	Gates, and incidental expenses	1 3 0	
		L.75 11 3	
1807. 7 acres once ploughed, and once harrowed, and sown with oats.	1807. 7 acres once ploughing, and once harrowing, at 12*s.* per acre .	4 4 0	1807. About 16 bushels of rye per acre. 2 a. = 32 bushels, at 6*s.* 3*d.* per bushel = L. 10 0
	28 bushels of seed oats, at 4*s.* per bushel	5 12 0	About 24 bushels of oats per acre. 7a. = 168 bushels, at 3*s.* 9*d.* per bushel . 31 10
	Corn reaping, carrying, stacking, &c. at 1*l.* 2*s.* per acre . .	9 18 0	
	Thrashing 4 quarters of rye, at 4*s.* 6*d.* per quarter , .	0 18 0	
	Do. 21 quarters of oats, at 1*s.* 2*d.* per quarter	1 4 6	Total value L.41 10
		L.21 16 6	

No. III. continued.

How cultivated.	Expense.	L.	s.	d.	Produce.
1808. Three times ploughed, and three times harrowed, and limed. 3 acres planted with potatoes, and 2 acres sown with turnips, which were eaten on the ground with sheep, the remainder of the field summer fallow.	1808.				About 220 bushels of potatoes per acre. 3 a.= 660 bushels, at 2s. per bushel . L.66 Turnips worth 2l. per acre. 2 acres at 2l. per acre . 4 — Total value L.70
	Three times ploughing, and three times harrowing, at 12s. per acre	16	4	0	
	36 chaldrons of lime and leading, at 15s. per chaldron .	27	0	0	
	Spreading do. at 9d. per chaldron	1	7	0	
	40 load of manure and leading, at 10s. per load	20	0	0	
	46 bushels of potatoe sets, at 2s. 6d. per bushel . .	5	15	0	
	Planting potatoes, at 4s. per acre	0	12	0	
	Turnip seed and sowing .	0	4	0	
	Turnips hoeing, at 7s. per acre	0	14	0	
	Potatoes taking up, carting, &c. at 2l. 10s. per acre . .	7	0	0	
		L.78	16	0	
1809. Once ploughed, and once harrowed, and sown with oats and seeds, (viz.) 14lb. of white clover, and 1 bushel of rye grass per acre.	1809.	L.	s.	d.	1809. About 32 bushels of oats per acre. 9 a. = 288 bushels, at 3s. 9d. per bushel=54l.
	Once ploughing, and once harrowing, at 10s. per acre . .	4	10	0	
	36 bushels of seed oats, at 4s. 6d. per bushel . . .	8	2	0	
	Seeds 1l. 4s. per acre . .	10	16	0	
	Rolling at 1s. per acre . .	0	9	0	
	Corn reaping, carrying, stacking, &c. at 1l. 2s. per acre . .	9	18	0	
	Thrashing 36 quarters of oats, at 1s. 2d. per quarter . . .	2	2	0	
	Carrying stones off the land .	0	18	0	
		L.36	15	0	
1810 and 1811. Pastured with mixed stock.					

Now worth 12s. per acre.

No. IV. contains 3 acres, 3 roods.

How cultivated.	Expense.				Produce.
1808. Pared and burnt, twice ploughed, and twice harrowed, limed, and sown with rye.	1808.	*L.*	*s.*	*d.*	
	Paring and burning, at 1*l.* 10*s.* per acre . . .	5	13	6	
	Twice ploughing, and twice harrowing, at 12*s.* per acre .	4	10	0	
	15 chaldrons of lime and leading, at 15*s.* per chaldron . .	11	5	0	
	Spreading do. a 9*d.* per chaldron	0	11	3	
	11 bushels of seed rye, at 7*s.* per bushel	3	17	0	
	To fencing 40 roods with posts, rails, and quickwood, at 5*s.* 9*d.* per rood	11	10	0	
	Gates and incidental expenses .	1	3	9	
		*L.*38	9	9	
1809.	1809.	*L.*	*s.*	*d.*	1809. About 24 bushels of rye per acre. 3 a. 3 r.=90 bushels, at 8*s.* 3*d.* per bushel=37*l.* 2*s.* 6*d.*
	Corn reaping, carrying, stacking, &c. at 1*l.* 2*s.* per acre .	4	2	6	
	Thrashing 11 quarters of rye, at 4*s.* 6*d.* per quarter . . .	2	4	0	
		*L.*6	6	6	
1810. Three times ploughed, and three times harrowed, limed, and sown with turnips, which were eaten on the ground with sheep.	1810.				1810. Turnips worth 3*l.* per acre. 3 a. 3 r. at 3*l.* per acre=11*l.* 5*s.*
	Three times ploughing, and three times harrowing, at 12*s.* per acre	6	12	9	
	15 chaldrons of lime and leading, at 15*s.* per chaldron . .	11	5	0	
	Spreading do. at 9*d.* per chaldron	0	11	3	
	Turnip seed and sowing .	0	7	6	
	Turnips hoeing, at 7*s.* per acre	1	6	3	
		*L.*20	2	0	
1811. Once ploughed, and once harrowed, and sown with oats and seeds, (viz.) 14lb. of white clover, and 8 bushels of hay seeds per acre.	1811.				1811. About 32 bushels of oats per acre. 3 a. 3 r.=120 bushels, at 3*s.* 9*d.* per bushel=22*l.* 10*s.*
	Once ploughing, and once harrowing, at 12*s.* per acre .	2	5	0	
	18 bushels of seed oats, at 4*s.* per bushel	3	12	0	
	Seeds 1*l.* 5*s.* per acre . .	4	13	9	
	Corn reaping, carrying, stacking, &c. at 1*l.* 2*s.* per acre . .	4	2	6	
	Thrashing 15 quarters of oats, at 1*s.* 2*d.* per quarter . .	0	17	6	
		*L.*15	10	9	

Now worth 13*s.* per acre.

No. V. contains 11 acres.

How cultivated.	Expense.				Produce.
1809.	1809.	L.	s.	d.	
Pared and burnt, twice ploughed, and twice harrowed, limed, and 4 a. sown with rye.	Paring and burning, at 1*l.* 10*s.* per acre . .	16	10	0	
	Twice ploughing and twice harrowing, at 13*s.* per acre .	14	6	0	
	44 Chaldrons of lime and leading, at 15*s.* per chaldron . .	33	0	0	
	Spreading do. at 9*d.* per chaldron .	1	13	0	
	10 bushels of seed rye, at 7*s.* 6*d.* per bushel . . .	3	15	0	
	To fencing 140 roods with posts and rails, at 5*s.* per rood . .	35	0	0	
	Gates and incidental expenses .	2	6	0	
		*L.*106	10	0	
1810.	1810.	L.	s.	d.	1810.
4 acres twice ploughed and twice harrowed. 2 acres sown with oats, and 5 acres planted with potatoes.	4 Acres, twice ploughing and twice harrowing, at 12*s.* per acre .	8	8	0	About 12 bushels of rye per acre. 4 acres = 48 bushels, a 7*s.* per bushel =*L.*16 16
	10 bushels of seed oats, at 3*s.* 6*d.* per bushel	1	15	0	About 24 bushels of oats per acre, 2 acres=48 bushels, at 3*s.* 6*d.* per bush. 8 8
	80 load of manure and leading, at 10*s.* per load . . .	40	0	0	About 230 bush. of potatoes per acre. 5a. = 1150 bush. at 2*s.* per bus= 115 0
	80 Bushels of potatoe sets, at 2*s.* 6*d.* per bushel . .	10	0	0	
	Planting potatoes, at 4*s.* per acre	1	0	0	
	Corn reaping, carrying, stacking, &c. at 1*l.* 2*s.* per acre . .	6	12	0	
	Thrashing 6 quarters of rye, at 4*s.* 6*d.* per quarter . .	1	7	0	Total value *L.*140 4
	Do. 6 quarters of oats, at 1*s.* 2*d.* per quarter . . .	0	7	0	
	Potatoes taking up, carting, &c. at 2*l.* 12*s.* per acre . .	13	0	0	
		*L.*82	9		
1811.	1811.				1811.
Three times ploughed and three times harrowed, limed and sown with turnips, which were eaten on the ground with sheep.	Three times ploughing and three times harrowing, at 12*s.* per acre	19	16	0	Turnips worth 3*l.* per acre. 11 acres, at 3*l.* per acre=33*l.*
	55 Chaldrons of lime and leading, at 15*s.* per chaldron . .	41	5	0	
	Spreading ditto, at 9*d.* per chaldron	2	1	3	
	Turnip seed and sowing . .	0	18	0	
	Turnips hoeing, at 6*s.* per acre .	3	6	0	
		*L.*67	6	3	

Now worth 14*s.* per acre.

No. VI. contains 6 acres.

How cultivated.	Expense.	L.	s.	d.	Produce.
1810.	1810.	L.	s.	d.	
Pared and burnt, twice ploughed and twice harrowed and limed. 5 acres sown with rye.	Paring and burning, at 1*l.* 10*s.* per acre	9	0	0	
	Twice ploughing and twice harrowing, at 13*s.* per acre . .	7	16	0	
	36 Chaldrons of lime and leading, at 15*s.* per chaldron . .	27	0	0	
	Spreading do. at 9*d.* per chaldron	1	0	7	
	12½ bushels of seed rye, at 7*s.* 6*d.*	4	13	9	
	To fencing 90 roods with posts and rails, at 5*s.* per rood . .	22	10	0	
	Gates and incidental expenses .	1	3	0	
		L.73	9	9	
1811.	1811.	L.	s.	d.	1811.
One acre twice ploughed and twice harrowed, and planted with potatoes.	One acre twice ploughing and twice harrowing	0	12	0	About 20 bushels of rye per acre. 5 a. = 100 bushels, at 6*s.* 6*d.* per bushel= L.32 10
	20 Load of manure and leading, at 10*s.* per load	10	0	0	260 bushels of potatoes, at 2*s.* per bushel= 26 0
	20 Bushels of potatoe sets, at 2*s.* 6*d.* per bushel	2	10	0	Total value L.58 10
	Planting potatoes . . .	0	4	0	
	Corn reaping, carrying, stacking, &c. at 1*l.* 2*s.* per acre . .	5	10	0	
	Thrashing 12½ quarters of rye, at 4*s.* per quarter . . .	2	10	0	
	Potatoes taking up, carting, &c. at 2*l.* 15*s.* per acre . .	2	15	0	
		L.24	1	0	

Now worth 11*s.* per acre.

	a.	r.	p.
No. 1. Contains . . .	4	0	0
2. Do.	4	3	0
3. Do.	9	0	0
4. Do.	3	3	0
5. Do. . .	11	0	0
6. Do. . .	6	0	0
	38	2	0

The premium of a silver cup, value £20. was obtained for this land in 1810, it being the greatest quantity offered for it, by exertions made during the four preceding years.

No. VII. contains 5 acres.

How cultivated.	Expense.	L.	s.	d.	Produce.
1808.	1808.	L.	s.	d.	1808.
Three acres pared and burnt, once ploughed and once harrowed, and sown with turnips, which were eaten on the ground with sheep. In the autumn once ploughed and once harrowed, limed, and sown with rye.	Paring and burning, at 1*l.* 10*s.* per acre	4	10	0	Turnips worth 2*l.* per acre. 3 acres at 2*l.* per acre=6*l.*
	Once ploughing and once harrowing, at 13*s.* per acre	1	19	0	
	Turnip seed and sowing	0	6	0	
	Turnips hoeing, at 7*s.* per acre	1	1	0	
	Once ploughing and once harrowing, at 12*s.* per acre	1	16	0	
	16 Chaldrons of lime and leading, at 15*s.* per chaldron	12	0	0	
	Spreading do. at 9*d.* per chaldron	0	12	0	
	9 Bushels of seed rye, at 7*s.* per bushel	3	3	0	
	To fencing 80 roods with posts, rails, and quickwood, at 5*s.* 6*d.* per rood	22	0	0	
	Gates and incidental expenses	1	3	0	
		*L.*48	10	0	
1809.	1809.	L.	s.	d.	1809.
2 acres pared and burnt, once ploughed and once harrowed, limed and sown with turnips, which were eaten on the ground with sheep.	Paring and burning, at 1*l.* 10*s.* per acre	3	0	0	Turnips worth 2*l.* per acre. 2 acres, at 2*l.* per acre= . *L.*4 0
	Once ploughing and once harrowing, at 13*s.* per acre	1	6	0	About 16 bushels of rye per acre. 3 acres=48 bushels, 8*s.* 3*d.* per bush. 19 16
	10 Chaldrons of lime and leading, at 15*s.* per chaldron	7	10	0	*L.*23 16
	Spreading do. at 9*d.* per chaldron	0	7	6	
	Turnip seed and sowing	0	4	0	
	Turnips hoeing, at 7*s.* per acre	0	14	0	
	Corn reaping, carrying, stacking, &c. at 1*l.* 2*s.* per acre	3	6	0	
	Thrashing 6 quarters of rye, at 4*s.* 6*d.* per quarter	1	7	0	
		*L.*17	14	6	
1810.	1810.	L.	s.	d.	1810.
Three times ploughed and three times harrowed, limed and sown with turnips, which were eaten on the ground with sheep.	Three times ploughing and three times harrowing, at 12*s.* per acre	9	0	0	Turnips worth 2*l.* 10*s.* per acre. 5 acres, at 2*l.* 10*s.* per acre—12*l.* 10*s.*
	15 Chaldrons of lime and leading, at 15*s.* per chaldron	11	5	0	
	Spreading do. at 9*d.* per chaldron	0	11	3	
	Turnip seed and sowing	0	10	0	
	Turnips hoeing, at 7*s.* per acre	1	15	0	
		*L.*23	1	3	

No. VII. continued.

How cultivated.	Expense.	L.	s.	d.	Produce.
1811. Once ploughed and harrowed, and sown with oats and seeds, viz. 8lb. of white clover, 2lb. of red clover, 2lb. of rib-grass, 2lb. of trefoil, and 1 bushel of rye-grass per acre.	1811.				1811. About 48 bushels of oats per acre. 5 acres=240 bushels, at 3s. 6d. per bushel=45l.
	Once ploughing and harrowing, at 12s. per acre	3	0	0	
	25 bushels of seed oats, at 4s. per bushel	5	0	0	
	Seeds, 1l. 1s. per acre	5	5	0	
	Corn reaping, carrying, stacking, &c. at 1l. 2s. per acre	5	10	0	
	Thrashing 30 quarters of oats, at 1s. 2d. per quarter	1	15	0	
		L.20	10	0	

Now worth 15s. per acre.

No. VIII. contains 16 acres.

How cultivated.	Expense.	L.	s.	d.	Produce.
1808. Pared and burnt, once ploughed and once harrowed, limed, and 14 acres sown with rye.	1808.				
	Paring and burning, at 1l. 12s. per acre	25	12	0	
	Once ploughing and once harrowing, at 13s. per acre	10	8	0	
	48 Chaldrons of lime and leading, at 15s. per chaldron	36	0	0	
	Spreading do. at 9d. per chaldron	1	16	0	
	35 Bushels of seed rye, at 7s. per bushel	12	5	0	
	To fencing 120 roods with posts, rails, and quickwood, at 5s. 6d. per rood	33	0	0	
	Gates and incidental expenses	1	3	0	
		L.120	4	0	
1809.	1809.				1809. About 16 bushels of rye per acre. 14 acres=224 bushels, at 8s. 3d. per bushel=94l. 8s.
	Corn reaping, carrying, stacking, &c. at 1l. 2s. per acre	15	8	0	
	Thrashing 28 quarters of rye, at 4s. 6d. per quarter	6	6	0	
		L.21	14	0	

No. VIII. continued.

How cultivated.	Expense.	L.	s.	d.	Produce.
1810. Three times ploughed and three times harrowed, limed, and sown with turnips, which were eaten on the ground with sheep.	1810. Three times ploughing and three times harrowing, at 12*s.* per acre	28	16	0	1811. Turnips worth 2*l.* 10*s.* per acre. 16 acres, at 2*l.* 10*s.* per acre=40*l.*
	48 chaldrons of lime and leading, at 15*s.* per chaldron	36	0	0	
	Spreading do. at 9*d.* per chaldron	1	16	0	
	Turnip seed and sowing	1	8	0	
	Turnips hoeing, at 7*s.* per acre	5	12	0	
		L.73	12	0	
1811. Once ploughed and once harrowed, and sown with oats and seeds, viz. 10lb. of white clover, 4lb. of rib-grass, and 1 bushel of rye-grass per acre.	1811. Once ploughing and once harrowing, at 12*s.* per acre	9	12	0	1811. About 40 bushels of oats per acre. 16 acres=640 bushels, at 3*s.* 9*d.* per bushel=120*l.*
	64 Bushels of seed oats, at 4*s.* per bushel	12	16	0	
	Seeds 1*l.* 2*s.* per acre	17	12	0	
	Corn reaping, carrying, stacking, &c. at 1*l.* 4*s.* per acre	19	4	0	
	Thrashing 80 quarters of oats, at 1*s.* 2*d.* per quarter	4	13	4	
		L.63	17	4	

Now worth 14*s.* per acre.

No. IX. contains 7 acres, 2 roods.

How cultivated.	Expense.	L.	s.	d.	Produce.
1809. Pared and burnt, three times ploughed and three times harrowed and limed, 4 acres sown with rape, which was eaten on the ground with sheep. In the autumn of 1809, once ploughed, once harrowed, and sown with rye.	1809. Paring and burning, at 1*l.* 12*s.* per acre	12	0	0	1809. Rape worth 10*s.* per acre. 4 acres, at 10*s.* per acre = 2*l.*
	Three times ploughing and three times harrowing, at 13*s.* per acre	14	12	6	
	Thirty chaldrons of lime and leading, at 15*s.* per chaldron	22	10	0	
	Spreading do. at 9*d.* per chaldron	1	2	6	
	Rape seed and sowing	0	8	0	
	Once ploughing and once harrowing, at 12*s.* per acre	4	10	0	
	16 Bushels of seed rye, at 7*s.* 6*d.* per bushel	6	0	0	
	To fencing 55 roods with posts, rails, and quickwood, at 5*s.* 6*d.* per rood	15	2	6	
	Gates and incidental expenses	1	2	0	
		L.77	7	6	

No. IX. continued.

How cultivated.	Expense.	L.	s.	d.	Produce.
1810.	1810.				1810.
	Corn reaping, carrying, stacking, &c. at 1*l*. per acre	7	10	0	About 12 bushels of rye per acre. 7a. 2r. = 90 bushels, at 7*s*. per bushel =31*l*. 10*s*.
	Thrashing 11 quarters of rye, at 4*s*. 6*d*. per quarter	2	9	6	
		L.9	19	6	
1811. Four times ploughed and four times harrowed, limed, manured, and sown with turnips, which were eaten on the ground with sheep.	1811. Four times ploughing and four times harrowing, at 12*s*. per acre	18	0	0	1811. Turnips worth 2*l*. 2*s*. per acre. 7a. 2r. at 2*l*. 2*s*. per acre=15*l*. 15*s*.
	22 Chaldrons of lime and leading, at 15*s*. per chaldron	16	10	0	
	Spreading do. at 9*d*. per chaldron	0	16	6	
	30 Load of manure and leading, at 6*s*. per load	15	0	0	
	Turnip seed and sowing	1	4	0	
	Turnips hoeing, at 7*s*. per acre	2	12	6	
		L.54	3	0	

Now worth 12*s*. per acre.

	a.	r.	p.
No. 8. Contains	16	0	0
9. Do,	7	2	0
	23	2	0

This land obtained the premium of a silver cup, value £15. in 1811; the encouragement annually held out. A preference was given to money.

No. X. contains 4 acres.

How cultivated.	Expense.	L.	s.	d.	Produce.
1806. Pared and burnt, twice ploughed and twice harrowed, limed, and sown with rye.	1806. Paring and burning at 1*l*. 10*s*. per acre	6	0	0	1806.
	Twice ploughing and twice harrowing, at 12*s*. per acre	4	16	0	
	12 chaldrons of lime and leading, at 15*s*. per chaldron	9	0	0	
	Spreading do. at 9*d*. per chaldron	0	9	0	
	8 bushels of seed-rye at 5*s*. 9*d*. per bushel	2	6	0	
	To fencing 56 roods with posts, rails, and quickwood, at 5*s*. 6*d*. per rood	15	8	0	
	Gates and incidental expenses	1	3	0	
		L.39	2	0	

No. X. continued.

How cultivated.	Expense.				Produce.
1807.	1807.				1807. About 20 bushels of rye per acre. 4 acres = 80 bushels, at 6*s*. 3*d*. per bushel=25*l*.
	Corn reaping, carrying, stacking, &c. at 18*s*. per acre	3	12	0	
	Thrashing 10 quarters of rye, at 5*s*. per quarter	2	10	0	
		L.6	2	0	
1808. Three times ploughed, and three times harrowed, limed, and sown with turnips, which were eaten on the ground with sheep.	1808.	L.	s.	d.	1808. Turnips worth 1*l*. per acre. 4 acres at 1*l*. per acre = 4*l*.
	Three times ploughing and three times harrowing, at 10*s*. per acre	6	0	0	
	16 Chaldrons of lime and leading, at 15*s*. per chaldron	12	0	0	
	Spreading ditto, at 9*d* per chaldron	0	12	0	
	Turnip seed and sowing	0	9	0	
	Turnips hoeing, at 7*s*. per acre	1	8	0	
		L.20	9	0	
1809. Once ploughed, and once harrowed, and sown with oats and seeds, (viz.) 8lb. of white clover, 2lb. of red clover, 2lb. of rib-grass, 2lb. of trefoil, and 1 bushel of rye-grass per acre.	1809.	L.	s.	d	1809. About 40 bushels of oats per acre. 4 acres = 160 bushels, at 3*s*. 9*d*. per bushel = 30.*l*
	Once ploughing and once harrowing, at 12*s* per acre	2	8	0	
	20 bushels of seed oats, at 4*s*. 6*d*. per bushel	4	10	0	
	Seeds, 1*l*. 1*s*. per acre	4	4	0	
	Corn reaping, carrying, stacking, &c. at 1*l*. 2*s*. per acre	4	8	0	
	Thrashing 20 quarters of oats, at 1*s*. 2*d*. per quarter	1	3	4	
	To making a pond	8	0	0	
		L.24	13	4	
1810. Pastured with mixed stock.					
1811. Mown.	1811.	L.	s.	d.	1811. About 1 ton of hay per acre, 4 a. = 4 ton, at 3*l*. 10*s*. per ton = L.14 0
	Mowing, haymaking, leading, stacking, &c. at 14*s*. per acre	2	16	0	4 a. of fog, at 15*s*. per acre 3 0
					Total value L.17 0

Now worth 14*s*. per acre.

No. XI. contains 4 acres.

How cultivated.	Expense.	L.	s.	d.	Produce.
1807. Pared and burnt, twice ploughed and twice harrowed, limed, and sown with rye.	1807. Paring and burning at 1*l.* 10*s.* per acre	6	0	0	
	Twice ploughing and twice harrowing at 12*s.* per acre . .	4	16	0	
	12 chaldrons of lime and leading at 15*s.* per chaldron -	9	0	0	
	Spreading do. at 9*d.* per chaldron	0	9	0	
	8 bushels of seed rye at 6*s.* 6*d.* per bushel	2	12	0	
	To fencing 45 roods with posts, rails, and quickwood at 5*s.* 6*d.* per rood	12	7	6	
	Gates and incidental expenses	1	2	0	
		L.36	6	6	
1808.	1808. Corn reaping, carrying, stacking, &c. at 18*s.* per acre - -	3	12	0	1808. About 20 bushels of rye per acre. 4 acres = 80 bushels at 6*s.* 9*d.* per bushel = 27*l.*
	Thrashing 10 quarters of rye at 4*s.* 6*d.* per acre - - -	2	5	0	
		L.5	17	0	
1809. Three times ploughed, three times harrowed, limed, and sown with turnips, which were eaten on the ground with sheep.	1809. Three times ploughing, and three times harrowing at 10*s.* per acre	6	0	0	1809. Turnips worth 1*l.* 10*s.* per acre. 4 acres at 1*l.* 10*s.* per acre = 6*l.*
	12 chaldrons of lime and leading at 15*s.* per chaldron - -	9	0	0	
	Spreading do. at 9*d.* per chaldron	0	9	0	
	Turnip seed, and sowing .	0	9	0	
	Turnips hoeing, at 7*s.* per acre	1	8	0	
		L.17	6	0	
1810. Once ploughed and once harrowed, and sown with oats and seeds, viz. 8lb. of white clover, 2lb. of red clover, 2lb. of rib-grass, 2lb. of trefoil, and one bushel of rye-grass per acre.	1810. Once ploughing and once harrowing, at 12*s.* per acre - - - -	2	8	0	1810. About 40 bushels of oats per acre. 4 acres = 160 bushels, at 3*s.* 6*d.* per bushel = 28*l.*
	20 bushels of seed oats, at 3*s.* 6*d.* per bushel - -	3	10	0	
	Seeds, 1*l* 1*s.* per acre - -	4	4	0	
	Corn reaping, carrying, stacking, &c. at 1*l.* 2*s.* per acre - -	4	8	0	
	Thrashing 20 quarters of oats, at 1*s.* 2*d.* per quarter - -	1	3	4	
		L.15	13	4	
1811. Pastured with mixed stock.					

Now worth 12*s.* per acre.

No. XII. contains 6 acres.

How cultivated.	Expense.	L.	s.	d.	Produce.
1808.	1808.	*L.*	*s.*	*d.*	
Pared and burnt, twice ploughed and twice harrowed and limed; three acres sown with rye.	Paring and burning at 1*l.* 10*s.* per acre	9	0	0	
	Twice ploughing and twice harrowing, at 12*s.* per acre - - -	7	4	0	
	18 chaldrons of lime and leading at 15*s.* per chaldron - -	13	10	0	
	Spreading do. at 9*d.* per chaldron -	0	13	6	
	6 bushels of seed rye at 7*s.* per bushel	2	2	0	
	To fencing 60 roods with posts, and rails, at 4*s.* 6*d.* per rood -	13	10	0	
	Gates and incidental expenses -	1	2	0	
		*L.*59	14	0	
1809.	1809.	*L.*	*s.*	*d.*	1809.
Three acres once ploughed and once harrowed, and sown with bear-barley.	3 acres once ploughing, and once harrowing, at 10*s.* per acre -	1	10	0	About 16 bushels of rye per acre. 3 a. = 48 bushels, at 8*s.* 3*d.* per bushel = *L.* 19 16
	6 bushels of seed barley, at 7*s.* per bushel - -	2	2	0	About 16 bushels of bear-barley per acre. 3 acres = 48 bushels, at 6*s.* per bushel = 14 8
	Corn reaping, carrying, stacking, &c. at 1*l.* 2*s.* per acre - -	6	12	0	
	Thrashing 12 quarters of rye and barley, at 4*s.* per quarter -	2	8	0	
		*L.*12	12	0	Total value *L.*34 4
1810.	1810.	*L.*	*s.*	*d.*	1810.
Three times ploughed and three times harrowed, limed, and 4 acres sown with turnips, which were eaten on the ground with sheep.	Three times ploughing and three times harrowing at 10*s.* per acre -	9	0	0	Turnips worth 1*l.* 10*s.* per acre. 4 acres, at 1*l.* 10*s.* per acre = 6*l.*
	20 chaldrons of lime and leading at 15*s.* per chaldron - -	15	0	0	
	Spreading do. at 9*d.* per chaldron	0	15	0	
	Turnip seed and sowing - -	0	9	0	
	Turnips hoeing, at 7*s.* per acre -	1	8	0	
		*L.*26	12	0	

No. XII. continued.

How cultivated.	Expense.	L.	s.	d.	Produce.
1811.	1811.				1811.
Once ploughed, and once harrowed. 3 acres sown with bear barley, and 3 acres sown with oats, also sown with clover and grass-seeds, viz. 8lb. of white clover, 2lb. of red-clover, 2lb. of rib-grass, 2lb. of trefoil, and one bushel of rye grass per acre.	Once ploughing, and once harrowing, at 12*s*. per acre - -	3	12	0	About 16 bushels of bear barley per acre. 3 acres=48 bushels, at 6*s*. 3*d*. per bush.=*L* 15 0
	7, bushels of seed-barley, at 6*s*. per bushel - - -	2	2	0	About 32 bushels of oats per acre, 3 a.=96 bushels, at 3*s*. 9*d*. per bushel= - 18 0
	15 bushels of seed-oats, at 4*s*. per bushel - - - -	3	0	0	Total value *L*.33 0
	Seeds, 1*l*. 1*s*. per acre - -	6	6	0	
	Corn reaping, carrying, stacking, &c. at 1*l*. 2*s*. per acre - -	6	12	0	
	Thrashing 6 quarters of bear-barley, at 3*s*. 6*d*. per quarter - -	1	1	0	
	Do. 12 quarters of oats, at 1*s*. 2*d*. per quarter - - -	0	14	0	
		L.23	7	0	

Now worth 12*s*. per acre.

No. XIII. contains 6 acres.

How cultivated.	Expense.	L.	s.	d.	Produce.
1809.	1809.				
Pared and burnt, once ploughed, and once harrowed, limed, and sown with rye.	Paring and burning, at 1*l*. 10*s*. per acre	9	0	0	
	Once ploughing, and once harrowing, at 12s. per acre - -	3	12	0	
	18 Chaldrons of lime and leading, at 15*s*. per chaldron - -	13	10	0	
	Spreading do. at 9*d*. per chaldron	0	13	6	
	12 Bushels of seed rye, at 7*s*. 6*d*. per bushel - - -	4	10	0	
	To fencing 50 roods with posts, rails, and quickwood, at 5*s*. 6*d*. per rood	13	15	0	
	Gates, and incidental expenses	1	2	0	
		L.46	2	6	
	1810.	£.	s.	d.	1810.
	Corn reaping, carrying, stacking, &c. at 18*s*. per acre - - -	5	8	0	About 8 bushels of rye per acre. 6 acres = 48 bushels, at 3*s*. 6*d*. per bushel = 8*l*. 8*s*.
	Thrashing 6 quarters of rye, at 4*s*. 6*d*. per quarter - -	1	7	0	
		L.6	15	0	

No. XIII. continued.

How cultivated.	Expense.	L.	s.	d.	Produce.
1811. Three times ploughed, and three times harrowed, and limed. 3 acres sown with turnips, which were eaten on the ground with sheep.	1811.				1811. Turnips worth 1*l.* 10*s.* per acre. 3 acres, at 1*l.* 10*s.* per acre=4*l.* 10*s.*
	Three times ploughing, and three times harrowing, at 10*s.* per acre	9	0	0	
	20 chaldrons of lime and leading, at 15*s.* per chaldron	15	0	0	
	Spreading do. at 9*d.* per chaldron	0	15	0	
	Turnip seed and sowing	0	4	6	
	Turnips hoeing, at 7*s.* per acre	1	1	0	
		L.26	0	6	

Now worth 11*s.* per acre.

	a.	r.	p.
No. 10. Contains	4	0	0
11. Do.	4	0	0
12. Do.	6	0	0
13. Do.	6	0	0
	20	0	0

The surface of No. XIV. previous to being broken up, was covered with stones, rushes, and ling.

No. XIV. contains 21 acres.

How cultivated.	Expense.	L.	s.	d.	Produce.
1808. Pared and burnt, once ploughed and once harrowed, and sown with rye.	1808.				
	Cutting and breaking stones, at 1*l.* 10*s.* per acre	31	10	0	
	Carrying stones off the land	10	10	0	
	Paring and burning, at 1*l.* 12*s.* per acre	33	12	0	
	Draining 35 roods, at 1*s.* per rood	1	15	0	
	Once ploughing and once harrowing, at 15*s.* per acre	15	15	0	
	52 bushels of seed rye, at 7*s.* per bushel	18	4	0	
	To 30 roods of fence wall, at 2*s.* 6*d.* per rood	3	15	0	
	To fencing 55 roods with a hedge and ditch, at 2*s.* 6*d.* per rood	6	17	6	
	To fencing 35 roods with posts and rails, at 5*s.* per rood	8	15	0	
	Gates and incidental expenses	1	3	0	
		L.131	16	6	

No. XIV. continued.

How cultivated.	Expenses.	L.	s.	d.	Produce.
1809.	1809.	*L.*	*s.*	*d.*	1809.
	Corn reaping, carrying, stacking, &c. at 1*l.* per acre . .	21	0	0	About 12 bushels of rye per acre. 21 acres=252 bushels, at 8*s.* 3*d.* per bushel=103*l.* 19*s.*
	Thrashing 31½ quarters of rye, at 4*s.* 6*d.* per quarter . .	7	1	9	
		*L.*28	1	9	
1810. Four times ploughed, four times harrowed, limed, manured, and 6 acres sown with rye.	1810.	*L.*	*s.*	*d.*	
	Four times ploughing and four times harrowing, at 10*s.* per acre .	42	0	0	
	63 chaldrons of lime and leading, at 18*s.* per chaldron . .	56	14	0	
	Spreading do. at 9*d.* per chaldron	2	7	3	
	15 bushels of seed rye, at 7*s.* 6*d.* per bushel	5	12	6	
	90 load of manure, leading and spreading, at 6*s.* per load . .	27	0	0	
		*L.*133	13	9	
1811. 15 acres, once ploughed and once harrowed, and sown with oats, also sown with clover and grass seeds, (viz.) 10lb. of white clover, 4lb. of rib-grass, and 1 bushel of rye-grass per acre.	1811.	*L.*	*s.*	*d.*	1811.
	15 acres, once ploughing, and once harrowing, at 12*s.* per acre. .	9	0	0	About 16 bushels of rye per acre, 6 acres=96 bushels, at 6*s.* 6*d.* per bushel = *L.*31 4
	80 bushels of seed oats, at 4*s.* per bushel . .	16	0	0	
	Seeds, 1*l.* 1*s.* per acre . .	22	1	0	About 28 bushels of oats per acre. 15 acres = 420 bushels, at 3*s.* 9*d.* per bushel = 78 15
	Corn reaping, carrying, stacking, &c. at 1*l.* 2*s.* per acre	23	2	0	
	Thrashing 12 quarters of rye, at 4*s.* 6*d.* per quarter . .	2	14	0	
	Thrashing 52½ quarters of oats, at at 1*s.* 2*d.* per quarter . .	3	1	3	Total value *L.*109 19
		*L.*75	18	3	

Now worth 11*s.* per acre.

We do hereby certify that the foregoing Numbers have been improved, and are now of the value herein stated.

JOHN FISHER.
DANIEL RICHARDSON, Sen.

The whole quantity by each reclaimed from a state of waste.

	a.	r.	p.
Mr. Duncomb's farm . .	58	2	20
John Bowes's do. . .	38	2	0
James Hawkins's do. . .	5	0	0
William Worthey's do. . .	23	0	0
Thomas Sharpe's do. . .	20	0	0
John Wilson's do. . .	21	0	0
	166	0	20

The present value put upon the land will perhaps appear rather low, when it is considered it is exempt from tythes.

Letter from Charles Duncombe *Esq. to the President of the Board of Agriculture, regarding the best System for the improvement of Waste Lands.*

My dear Sir, 24 *Arlington-street, April* 10*th*, 1812.

In answer to the letter I had the honour to receive from you, dated the 8th inst. I beg to observe, it would probably have been in my power to have returned, in the course of another year or two, answers of a much more satisfactory nature to the queries you suggest, than I am enabled to do at this present time. The improvements are in their infancy, and I have deemed it most proper, for different reasons, to adopt a system that appeared to be most likely of obtaining such a permanent benefit, as would be most conducive to success.

1. By paring and burning, it is thought, the matted substance of peat, and the roots of the ling, are pulverized, and reduced to a substance that assists vegetation; this sort of land is likewise by this means more immediately brought into cultivation; I should consequently prefer it, though the most expensive mode.

2. It is a great object to grow, for a first crop, that grain that will come to maturity. The soil being light, the situation elevated, the air cold, rye has been observed to produce the best first crop, though I saw last year a very good crop of oats; but the land was of a better quality, had possibly, some years ago, been in a state of cultivation, but had become over-run with ling and bramble bushes.

3. Potatoes would unquestionably be the most productive crop, and, I humbly conceive, might with safety be recommended in new enclosures of waste lands, if you can command hands in sufficient number, for paring and burning, have your teams at leisure to work the ground so as sufficiently to reduce it in time, and have a command of a requisite supply of long dung.

4. Lime I conceive of infinite assistance in decomposing the vegetable substances, and assisting in ameliorating the soil. As yet no ling or noxious vegetable has appeared to require the breaking up of any fields reclaimed from thorns; when that should prove requisite, the process must depend on circumstances.

5. When once laid down to grass with artificial seeds, it is of advantage to keep it in pasture, and this is yet in such infancy as not to require its being broken up. It will be perceived in the account submitted to the Board, that there are only

two instances of mowing; those two fields were in a highly flourishing state last summer.

6. Artificial grasses are generally said to *decline* after two years; and till very lately an idea prevailed that white clover would not succeed in heathy soil.

7. Cocksfoot I have never known grown, but shall certainly try some of it next summer.

8. The papers containing the improvements of waste land, arrived from the country three days only prior to the day fixed by the Board of Agriculture for the reception of claims, so that I had little time to examine with due attention the different values put upon each parcel of land; but I have little hesitation in saying, that by conversation with my steward, it is very probable many reasons may have weighed with him, as well as with the individuals that accompanied him to view the improvements, to induce them to put a rent on the fields much lower than they might obtain, without going to the extremity of setting them up to auction.

Wishing the above answers may conduce in any respect to the object you have in view, I am

Yours, very faithfully,

C. DUNCOMBE.

Rt. Hon. Sir John Sinclair, Bart.
&c. &c. &c.

No. XXXI.

Observations on Larch. Transmitted to the Commissioners of Naval Revision in May, 1807.

My dear Sir, *Dunkeld, February 19, 1812.*

I should have sent you the enclosed account of larch sooner, had I not been about to make out a statement respecting planting, up to the present period, which, however, I have not yet been able to spare time to effect. When I can make it out I will send you a copy; at present I shall only add, that I have used the larch extensively, and sold considerable quantities since the date of the enclosed paper, and that 200 ton of larch is now on trial in a variety of ways, under the direction of the Navy Board; and, as far as I can learn, is much liked.

I remain, my dear Sir,
Your's sincerely, &c. &c.

Sir John Sinclair, Bart. &c. &c. ATHOLL.

Copy of a Letter to the Duke of Atholl.

My Lord Duke,

I had the pleasure of receiving your Grace's letter of the 19th, accompanied by some observations on larch, which are by far the most important that have been communicated to the Board of Agriculture, regarding that interesting subject.

I propose setting off for London during the course of next week, and shall take the earliest opportunity of laying it before the Board, to whom such a communication, from so respectable a quarter, cannot fail to be highly acceptable. It is an additional argument in favour of the larch, that it is found now to possess such valuable tanning properties.

I have the honour to be,
With great regard,
Your Grace's faithful and obedient servant,

Charlotte-square, Edinburgh, 21st February, 1812. JOHN SINCLAIR.

Larch.

The introduction of this most valuable tree into Scotland, at least into the county of Perth, took place in the year 1738, when a Highland gentleman, Mr. Menzies, of Glenlyon (Perthshire), brought a few small plants from London.

Some of these plants he left at Monzie, near Crieff; some at Dunkeld; and the remainder he carried home, where the last was cut within these few years, of a great size. The four left at Monzie are in full vigour [1807], the largest nearly thirteen feet in circumference, at three feet and a half above the ground. Those left at Dunkeld [1807] are also in full vigour, though, at first, they were placed in a green-house, but not thriving, were turned out. The largest is about twelve feet in girth, at three feet and a half above the ground, and is computed to contain four ton or load of solid timber, or one hundred and sixty square feet. Nearly ten years elapsed before any more larch were planted at Dunkeld. A few, however, were planted at Blair in that interval. The larch, however, planted between the years 1740 and 1750, were inconsiderable in point of number. For the planting of the rocky mountains round Dunkeld and Blair, with a view to their growing wood, which has since been done, would at that time have been treated as a chimerical idea. The plantations on the lower grounds were necessarily small in extent.

Trials of Larch.

It is now thirty years [1777] since I have cut and used larch for different purposes: and as yet I have met with no instance to induce me to depart from my opinion, that larch is the most valuable acquisition, in point of useful timber, that has ever been introduced into Scotland: and I speak from having used and cut larch of from fifty to sixty years growth.

The small larch I have used were thinned out of plantations for upright paling, rails, and hurdles. Those fit for sawing were sawn through the middle; the smaller used round, with the bark on. I have found young larch so used more durable than oak copse-wood of twenty-four years growth.

The larger and older larch which I have cut, have been used for a variety of purposes. Boats built of it have been found sound, when the ribs made of oak, forty years old, were decayed. I have for years built all my ferry and fishing-boats of larch.

In mill-work, and especially in mill-axles (where oak only used formerly to be employed), larch has been substituted [1806] with the best effect. Last winter, in cutting up an old decayed mill-wheel, those parts of the water-cogs which had been repaired with larch [1786] about twenty years before, though black on the surface, on the hatchet being applied, were found as sound and fresh as when put up.

There is not a sufficient quantity of larch of fit growth to bring that wood into general use for country purposes; but such as has been cut and sold, has brought two shillings per foot, in some instances, more. About seven years ago [1800], I received twelve guineas for a single larch-tree of fifty years growth. I was, at the same time, offered twenty pounds for another larch, which I declined cutting. The tree sold had eighty-nine solid square feet of wood, and the purchasers cut two, if not three, axles for mills out of it.

Last year [1806] I cut out twenty larch trees from a clump, where they stood too thick. I left the finest trees standing, and received one hundred guineas for the twenty trees taken out, being at the rate of two shillings per foot. The largest of the twenty trees measured one hundred and five feet in length, five feet eleven inches in girth, at four feet from the ground, and contained ninety-four square feet of timber. One tree measured one hundred and six feet; two, one hundred and seven; and one, one hundred and nine feet in length; but, being drawn up by standing too close, did not contain so much solid wood as the first.

It is not in the quality only of the wood, that I consider the larch a great acquisition, but in the nature of the ground, where it will not only grow luxuriantly, but, I am persuaded, will arrive at a size fit for any purpose to which wood can be applied.

The lower range of the Grampian hills, which extend to Dunkeld, are in altitude from one thousand to twelve hundred feet above the level of the sea; they are, in general, barren, and are composed of mountain schist, slate, and iron-stone. Up to the highest tops of these, larch grow luxuriantly, where the Scotch fir, formerly considered the hardiest tree of the north, cannot rear its head. In considerable tracks, where fragments of shivered rocks are strewed so thick that vegetation scarcely meets the eye, the larch puts out as strong and vigorous shoots as are to be found in the valleys below, or in the most sheltered situations.

I have been employed, for the last five years, in forming a very extensive

plantation of larch, on mountains similar to what I have described. The plantation embraces a tract of nearly eighteen hundred Scotch acres, nearly fifteen hundred of which I have already planted [1807] mostly with larch; placing Scotch fir only in the wet grounds where larch will not grow, and mixing spruce on the highest points with the larch; finding, from experience, that that tree is next in value to, and thrives in alpine situations almost equally with, the larch.

In all the larch which I have cut, I have never met with one instance of decay; but I have seen larch cut in wet situations and tilly soil on low moors some miles from Dunkeld, which were decaying at the heart. The larch is certainly an alpine tree, and does not thrive in wet situations.

About twelve years ago [1795] a species of blight appeared on the larch, which in low situations destroyed numbers. The season in which this was observed to any extent, the frosts were very severe late in the spring, and the clouds of frost fog, which rested on the larch, on calm mornings, when just coming into leaf, produced the blight. I did not find trees above twenty-five or thirty feet in height affected by it; neither did it appear at all, on the higher grounds, where a slight breeze of air could shake the trees. For eight or ten years past severe frosts at the end of spring and beginning of summer have partially brought blights, nearly destroying the flower of the larch; which has prevented my having been able to obtain larch-seed in the quantity I wished in order to carry my intention into effect, to cover all the mountainous tract near Dunkeld belonging in property to me, with the larch, which I am persuaded, at the distance of sixty or seventy years from planting, will be fit for most naval purposes.

The comparative value of larch and Scotch fir, will not bear calculation. I sold a larch [1800] of fifty years old for twelve guineas. A fir of the same age, and in the same soil, was worth fifteen shillings. A fall of snow will destroy in one night, and break and tear down sometimes more than one third of a fir plantation. This I have often experienced at all ages. High winds also destroy firs in numbers. The larch are never broken by snow; and very seldom torn up by winds, and then only in single trees. Scotch firs are bad and shabby growers, (with me at least) at about eight hundred feet of altitude. Larch grow luxuriantly some hundred feet higher.

The late Duke of Atholl, my father, was the first who formed plantations around Dunkeld or Blair [1765] to any extent. He only began forty-two years ago.

The quantity of old larch I could at present [1807] spare, therefore, cannot be considerable; but should the Board, from any thing I have said of its durability in boats, &c. be inclined to make trials for naval purposes, I could perhaps furnish for *that purpose* forty or fifty ton. Or, I should be extremely ready and happy to carry into effect experiments, if the Board should think fit to direct the making of any, to prove the strength, weight, durability, &c. &c. of *larch-wood.*

I would not, Gentlemen, have troubled you with the foregoing detail, but from a thorough conviction, that larch timber may be used, in many instances, as a *substitute for oak ;*

That this substitute may be had of a prime quality in sixty or seventy years from the period of planting;

And, lastly, that this substitute may be the produce of otherwise barren and unprofitable mountains; whereas oak timber will always be found to thrive best in lands either taken from, or well adapted to agricultural purposes, and more particularly to the growth of wheat.

No. XXXII.

On Tanning with the Bark of Larch. *By* Thomas White, *Esq.*

Turf Coffe-house, Edinburgh, Feb. 18, 1812.

Sir,

From the great pleasure that I know you always take in communicating and extending useful knowledge and improvement, and from the honourable and important situation you hold, as President to the Board of Agriculture, I trouble you with this letter, which, I flatter myself, will be the means of affording great benefit to the country at large, as well as considerable emolument to those in possession of woods, from a discovery that I have made of converting to profit, what was formerly thrown away as good for nothing.

Some years ago, after my late father's plantations at Woodlands, near Durham, had made considerable progress (for which he had the honour of receiving from the Society of Arts and Sciences in London nine gold and two silver medals), he, amongst other projects, thought, that the bark of the larch-tree might be useful in tanning leather; but was prevailed upon to give up the experiment, by some person who, I suppose, classed this tree with the fir-tribe instead of the cedar. However, in June last, whilst some workmen were taking off the bark from a number of larch-trees intended for building, they found the nails of their fingers stained, which induced me to try whether it would tan leather or not, a purpose I was very soon satisfied it would answer most effectually. I then procured two calf-skins, of equal price, weight, and substance, and immersed one in an infusion of oak-bark, of amazing fine quality, such as can rarely be purchased, and the other in the same proportion of larch-bark, from a very small tree, each skin remaining exactly the same time in its respective tan-pit; and during the operation I repeatedly weighed a measure of larch-liquor against the oak, and always found the former to preponderate; the consequence of which was, that the skin tanned with larch felt thicker in the hand, and heavier, and was also finer in the grain, and of a lighter colour.

I sent these two skins to the Society of Arts and Sciences in August last, and put as many hides, equally divided, into each of the two tan-pits as nearly exhausted their strength; at the expiration of which time, the larch liquid appeared to have the superiority both in astringency and weight.

I have been since employed in tanning hides of cows and horses with larch-bark, which of course require much longer time than calf-skins, but promise just as fair to arrive at perfection. I have tried also equal quantities of larch and oak-barks, mashed in hot water, and applied when cold to the skins, and with the same effect as in the former case. I also compared birch with the larch, but was soon convinced, that the former, from its slowness in tanning, and apparently exhausted state, after proceeding a certain length, was very inferiour, and yet it is sold in my neighbourhood for half the price of oak. What then, I ask, must be the value of larch?

Although I am happy to think, Sir, that the discovery, from the immense plantations in this country, will, in some measure, make the importation of bark unnecessary, I feel an additional pleasure in the certainty of its answering other very important purposes, viz. of promoting planting, and inducing gentlemen to thin their woods, which, in my professional excursions of laying out grounds, and planting by contract, I have often most strenuously recommended, but without prevailing upon some to do so, from the difficulty of selling the weedings, which expense will be much more than repaid by the price of the bark, should the body of the tree even be suffered to rot on the ground.

It must be observed, that oak bark can only be taken from the tree during about two months in the year, whereas larch can be collected from about March to the end of August, and at infinitely a cheaper rate, as a whole tree, whatever length it may be, can be stripped from one end to the other entire with the greatest ease.

Since leaving Woodlands, I have received a most favourable report from a tanner, who has converted the leather into shoes, of which he speaks very highly, as well as of its superiority for gloves, saddles, &c.; he adds also, that, in his opinion, it is not only equal to oak-bark, but even better, on account of its tanning quicker.

I beg leave to return the leather, which I have shewn to day to Doctor Hope,

who was so good as to speak favourably of it. I have also enquired of Patterson, the sadler, about buff leather, who manufactures it; and he says no bark is used in the process, but only oil.

I have the honour to be,

Sir,

Your most obedient humble servant,

THOMAS WHITE.

Rt. Hon. Sir John Sinclair, Bart. &c.

Memorandum. In another communication from Mr. White, dated June 26, 1812, he states that "on passing through Hexham, he was happy to see shoes made from leather tanned with the larch-bark, and was told that the glovers were so well convinced of its excellency, that they declared they would use nothing else, if they could get a sufficient supply:" in addition to which pleasing intelligence, he has had an order for much more larch bark annually, than he can supply, for making leather of a light colour for book-binding, &c.

The experiments made by Mr. White, induce him to believe, that larch-bark is not only equal to oak in every particular, but superiour in regard to the articles above mentioned, and for many other purposes.

No. XXXII.

Communication on the best Mode of planting Trees, and other interesting Subjects. By A. P. Hove, *Esq. a Native of Poland: Addressed to the Right Hon. Sir* John Sinclair, *Bart. President of the Board of Agriculture.*

Sir, *Rathbone-place, 9th June,* 1812.

I have the honour to return you herewith the paper on woods and plantations, that you had the kindness to forward to me for my perusal and remarks.

The author appears to me to have discussed the subject in such a manner, as to leave but few opportunities for making any useful remarks; my opinion, however, is decidedly against the *planting* of forests, and cannot express in terms too strong the preference that should be given to the propagation of the various sorts of timber-trees, by *sowing* the seeds of them, where they are intended to mature, in the soil most congenial, and in situations the most favourable to every species. It is on this head to be remarked, that the digging a large extent of land for the reception of the trees, and the subsequent labour in planting them, is attended with much expense (a circumstance of itself not unworthy of consideration), and the trees so planted, never grow with that freedom and luxuriance as those raised from seed on the spot; these observations particularly apply to the oak, birch, and all the pine tribe, more especially when the plantations of them are formed in exposed situations; because as the stem and head of a seedling plant increase only in proportion to the nourishment it receives through, and the support imparted to it from its root, it is better enabled to sustain the violence of the wind (which by forcibly agitating it, impedes its growth) than the tree newly planted, which by being deprived of a great proportion of its roots, has, consequently, lost much of its natural power of affording to the plants that nutriment, so necessary to its external and immediate protection.

In confirmation of these remarks, I have noticed in Poland a plantation formed partly from seeds, and partly from plants, sown and planted at the same time; and although every possible care and attention were paid to the removal of the young trees from the adjacent forests, and also in the planting of them, yet in the

period of seven years the seedling plants by far exceeded those that were removed, both in size and luxuriance. The same reasons do not, however, operate so forcibly against the planting of ash; this tree being provided by nature with numerous fibrous roots, it consequently suffers but little in its removal.

In Poland there are three sorts of oaks (the quercus); robur, or the common; the cerris; and another sort, with which I have not met any where else in my travels in Europe, except on the river Bug: this is the sort which supplies the English navy with their crown planks. This tree has hardly any collateral branches in its infant state, which is so common to all the other known sorts. After having raised itself from the acorn to the height of seven feet, it assumes a diagonal form, or position, and the tops of such trees in the plantations are quite entangled with each other: but on arriving at the age of fifteen or sixteen years, they acquire a height of from twenty-four to thirty feet, begin to form a crown, gradually erect themselves, and become majestic and stately trees. The leaves of this tree are much narrower, longer, and more deeply cut in than the robur; the bark is perfectly smooth, and the acorn long and pointed. On my leaving the district of Belsk, where they grew, five years ago, but few of these trees remained, as the Jews, who are the renters and fellers of timber, had cut them down indiscriminately, with a view to immediate profit. These rich and immense forests, which skirted the river Bug, and wherein I botanised sixteen years ago, are now no more, there remaining only a few trees very thinly scattered, which owe their existence to the circumstance only of their being in situations far distant from the river. I procured a considerable quantity of the acorns on my leaving Poland, with the view of enriching this country; but having sent my collections *via* Dantzig, where the French arrived shortly after, I am, at this moment, ignorant of the manner in which they have been disposed of. Two hundred bushels of acorns of this valuable species, would certainly be a great acquisition, if not a real source of riches, to this country; they would answer for hedge-planting perfectly well.

The Swirk is another tree that would be of great value to this country; it is a species of fir, that is peculiar to the mountains of Pokutia, or mountains of Penitence, where Ovid was exiled. The height and bulk of this tree is incredible; and it is not very nice in regard to soil, as it grows in the most rocky and inclement situations on these mountains. The white ash of the Palatinate of Belsk, and a sort of maple, are trees that would also be of great value in England; they both grow to

an immense height. The Polish King, John Sobiesky, was so struck with the size and beauty of these trees, that he built himself a residence in the neighbourhood of the forests where they grew, and formed a large town, which is still in existence, to which he gave the name of Jaworow; Jawor denoting, in the Polish language, this species of acer. The black birch, in the same Palatinate, in the circle of Mosciska,* is a new and unknown species; the wood of this tree is more solid than in any other of this genus, on which account the wheelwrights and millwrights give it the preference. The quality of this wood is in such repute, that it is sent to Warsaw, and all over Prussia, for their use. I have been thus particular in stating to you the places where the above valuable trees grow, deeming it not improbable, that through your influence, and under your patronage, a proper person may, at some period not far distant, be sent abroad by government to obtain seed of them. Should such a mission take place, I shall be happy to communicate such information, with regard to the method that should be pursued, as I am possessed of, and give such further details on the subject as will tend to facilitate the object in view. The greatest precaution will be necessary, as the government of Gallitia is jealous in the extreme in the admission of any stranger into that district, having at the mouth of the pass that leads to the Pokutian mountains, saline works, which no stranger whatever is allowed to visit; the jealousy is so great, that I have witnessed gentlemens' stewards, who were possessed of the least education, sent back to their employers, from their estates, and illiterate people were, by obligation, sent in return to supply their places. This is the true reason why the Poles know so little of their own country; even the Court of Vienna, who has possessed that territory for nearly forty years, is but little acquainted with the real produce of these mountains.

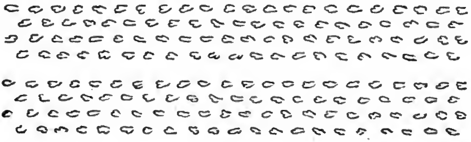
The following observations that I made some years ago at the Cape of Good Hope, and also in the vicinity of Dantzig, may be perhaps usefully applied to such plantations as may be in situations exposed to powerful winds, thereby impeding the growth of the trees. In the Quada monsoon at the Cape, and in some months of the year at Dantzig, the growth of trees is very much checked by the powerful winds; they lean always in the direction to which the wind points, and their tops have the appearance of being clipped with shears. This circumstance has induced me to remark, that the trees in the direction of the wind suffered

* An estate belonging to Count Palatine de Cetner.

much less than those that opposed or crossed its course; I always, therefore, recommended my friends abroad to plant their fruit-trees in a direct line, and with the course of the prevailing winds, by which means its pressure was, in a great measure, broken when they grew up, having a more free and unobstructed passage. The method that appears the most preferable, is to plant the trees in the form of a triangle, sixteen feet asunder, always in a line, leaving an intermediate space, or alley, of thirty feet between the rows, which may either be cultivated with grain, or left for pasture, as the soil and situation of the ground will admit, or the discretion of the proprietor may direct.

Plantation of Fruit Trees in a Triangle.

Plantation of Forest Trees.



Honey, another agricultural production, respecting which you are anxious to procure information, is in Poland divided into three classes, namely Lipiec, Leszny, Stepowey prasznymird.

Lipiec is gathered by the bees from the lime-tree alone, and is considered on the continent most valuable, not only for the superiority of its flavour, but also for the estimation in which it is held, as an arcanum, in pulmonary complaints, containing very little wax, and being consequently less heating in its nature; it is as white as

milk, and is only to be met with in the lime forests, in the neighbourhood of the town of Kowno, in Lithuania. The great demand for this honey occasions it to bear a high price, in so much that I have known a small barrel, containing hardly one pound weight, sell for two ducats on the spot. This species of the lime-tree is peculiar to the province of Lithuania; it is quite different from all the rest of the genus Tilia that I met with in my researches in Poland, and is called Kamienna Lipa, or stone-lime. It is a stately tree, and grows in the shape of a pyramid; the leaves are very small, and the twigs uncommonly slender; it flowers in the months of June and July; the flowers are very minute, but more abundant than in any other species. In the Polish language, the month of June, which is called Lipiec, derives its name from the flowering of this tree, as the month of July derives its name from the Cocus Polonicus, called by the Poles Czerwiec, in which month the ova are gathered. The inhabitants have no regular bee-hives about Kowno; every peasant who is desirous of rearing bees, goes into the forest and district belonging to his master, without even his leave, makes a longitudinal hollow aperture or apertures in the trunk of a tree, or in the collateral branches, about three feet in length, one foot broad, and about a foot deep, where he deposits his bees, leaves them some food, but pays very little further attention to them, until late in the autumn; when, after cutting out some of their honey, and leaving some for their maintenance, he secures the aperture properly with clay and straw against the frost and inclemency of the approaching season; these tenements (if they may be so called), with their inhabitants, and the produce of their labour, are then become his indisputable property; he may sell them, transfer them; in short, he may do whatever he pleases with them; and never is it heard that any depredation is committed on them, (the bear excepted). In Poland the laws are particularly severe against robbers, or destroyers of this property, punishing the offender, when detected, by cutting out the navel, and drawing out his intestines round and round the very tree which he has robbed. Such thefts have happened, but not in my memory.

The following spring, the proprietor goes again to the forest, examines the bees, and ascertains whether there is sufficient food left, till they are able to maintain themselves; should there not be a sufficient quantity, he deposits with them as much as he judges necessary till the spring-blossom appears. If he observes that his stock has not decreased by mortality, he makes more of these

apertures in the collateral branches, or in the trunk of the tree, that in case the bees should swarm in his absence, they may have a ready asylum. In the autumn he visits them again, carries the June and July work away with him, which is the Lipiec, and leaves only that part for their food which was gathered by them before, and after the flowering of the lime-tree. I have not the least doubt, that if this species of the lime-tree were introduced, and attention paid to them, that honey equally excellent and valuable might be produced in this country. The mead made from this honey is excellent; it is sold at Kowno, Grodno, and Vilna, at the rate of eight pounds sterling the dozen.

The next class of honey, which is inferior in a great degree to the Lipiec, being only for the common mead, is that of the pine forests; the inhabitants of which make apertures in the pine-trees similar to those near Kowno, and pay the same attention, in regard to the security of the bees, and their maintenance. The wax is also much inferior in quality; it requires more trouble in the bleaching, and is only made use of in the churches.

The third class of honey is the Stepowey, or the honey from the plains where there is an abundance of perennial plants, and hardly any wood. The province of Ukraine produces the very best, and also the very best wax. In that province the peasants pay particular attention to this branch of economy, as it is the only resource they have to enable them to defray the taxes levied in Russia; and they consider the produce of bees equal to ready money, wheat, and other species of corn, being so very fluctuating in price, some years it being of so little value, that it is not worth the peasant's trouble to gather it in: this has happened in the Ukraine four times in twelve years; but honey and wax having always a great demand all over Europe, and even Turkey, some of the peasants have from four to five hundred Ule, or logs of wood, in their bee-gardens, which are called Pasieka, or bee-hives; these logs are about six feet high, commonly of birch-wood (the bees prefer the birch to any other wood) hollowed out in the middle for about five feet; several lamina of thin boards are nailed before the aperture, and but a small hole left in the middle of one of them for the entrance of the bees. As the bees are often capricious at the beginning of their work, frequently commencing it at the front rather than the back, the peasants cover the aperture with a number of these thin boards, instead of one entire board, for fear of disturbing them, should they have begun their work at the front. It may appear extraordinary,

but it is nevertheless true, that in some favourable seasons, this aperture of five feet in length, and a foot wide, is full before August; and the peasants are obliged to take the produce long before the usual time, with the view of giving room to the bees to continue their work, so favourable is the harvest some summers.

The bee-gardens are chosen in the plains where the perennial plants are most abundant, that the bee may have but little way to carry home the produce of her labour; they are of circular form, about 150 yards in diameter, enclosed with a fence of reeds, or brush-wood, and a thatching over them of about five feet for protection, and to keep out the rain and snow; this is supported by poles from the inside, and a bank of earth is also thrown up, to keep out the snow from penetrating in the winter: in the middle a few fruit-trees are planted to break the wind, as also hawthorns, and other underwood, round the enclosure, with the same view. The hives are planted under cover, in the inside, round the fence; and in the winter they are well secured with straw from the frost. The plants for which the bees have a preference, are the Thymus serpyllum, Hyssopus officinalis, Cerinthe maculata, and the Polygonnum fagopyrum.

The process of brewing mead in Poland is very simple: the proportion is three parts of water to one of honey, and 50 lb. of mild hops to 160 gallons, which is called a Waar, or a brewing. When the water is boiling, both the honey and hops are thrown into it, and it is kept stirring until it becomes milk warm; it is then put into a large cask, and allowed to ferment for a few days; it is then drawn off into another cask, wherein there has been aqua-vita or whiskey, bunged quite close, and afterwards taken to the cellar, which in this country are excellent and cool. This mead becomes good in three years time; and by keeping, it improves like many sorts of wine. The mead for immediate drink is made from malt, hops, and honey, in the same proportion, and undergoes a similar process. In Hungary it is usual to put ginger in mead. There are other sorts of mead in Poland, as Wisniak, Dereniak, Maliniak; they are made of honey, wild cherries, berries of the Cornus mascula, and raspberries; they all undergo the same process, and are most excellent and wholesome after a few years keeping. I never saw a gouty man in those provinces where mead is in common use. The Lipiec is made in the same way; but it contains the honey and pure water only. The honey gathered by the bees from the Azalea pontica, at Oczakow, and in Potesia in Poland, is of an intoxicating nature; it produces nausea, and is used only for

medical purposes, chiefly in rheumatism, scrophula, and eruption of the skin, in which complaints it has been attended with great success. In a disease among the hogs called Wengry (a sort of plague among these animals), a decoction of the leaves and buds of this plant is given, with the greatest effect, and produces almost instantaneous relief. This disease attacks the hogs with a swelling of their throat, and terminates in large hard knots, not unlike the plague, on which the decoction acts as a digestive, abates the fever directly in the first stage, and suppurates the knots. It is used in Turkey, I understand, with the same view (the plague). Tournefort makes mention in his Travels of this honey.

Having lately obtained from my friend, Isaac Solly, Esq. merchant, of St. Mary Axe, a small phial of mead, made from the Lipiec honey, I have taken the liberty to send it to you by way of specimen.

I have the honour to be,

With sentiments of respect and esteem,

Your most faithful humble Servant,

A. P. HOVE.

POSTSCRIPT.

PERMIT me to avail myself of this opportunity, to communicate to you such facts and observations as have occurred to me on another object of your solicitation, namely, the Eau Medicinal. This celebrated medicine has been known among the nobles and higher classes of my countrymen for above twenty years; but it was introduced into common use by my friend, Doctor Wolff, of Warsaw, about twelve years ago, in rheumatic, gouty, and in every species of epileptic complaints. My reason for supposing that the Eau Medicinal is an infusion of the Lycoperdon Bovista, at least that it forms the greater part of its ingredients, is from the similitude in the effects produced by the Eau Medicinal and the Lycoperdon in the human frame; and also from the use made of it, in like complaints, by the inhabitants of the Ukraine from time immemorial. By the following circumstance I became acquainted with the medicinal qualities of the Lycoperdon.

A well informed noble young Turk, Mr. Ibrahim Basha, who was taken prisoner by Prince Orloff, at the battle of Chesme, was the first who brought this medicine from France to Poland. This gentleman, after being liberated by the Russians on account of his superior talents, was taken notice of, and protected by my countryman, Count John Krayezy Potocki, a gentleman celebrated in Poland for his travels to Tartary, Asia, Egypt, and Morocco; and I believe the first European to whom the town of Hussa, and its

extensive trade from Morocco was first known, and who was accompanied in these travels by Ibrahim. During a residence in France, Ibrahim got a fit of the gout; the Eau Medicinal was administered to him by a Frenchman, and it relieved him instantly. He had several more paroxysms of the gout during his stay in France, and always found the Eau of service to him; therefore, on leaving Paris, he took a considerable quantity with him to Poland. The gout, as he thought, had left him entirely, having had no return of it for eight years. Thinking himself quite secure, he so liberally assisted his friends with the medicine, that when he left Warsaw, for the Count's estate in the Ukraine, he had but few bottles left; there, leading an inactive and rather an indulgent life, the gout returned as violently as before, and so repeatedly, that the few remaining bottles were soon exhausted. It was, unfortunately, at a period when the disagreement between Russia and France took place, and all communication with the latter country had ceased, in consequence of which no supply of the Eau could be obtained. Just at that time I happened to call on Ibrahim, on my return from the Black Sea, and found him in the most deplorable and cruel state, swollen as with the dropsy, and all the parts highly inflamed. I did every thing in my power to relieve him, but without effect. One morning a Jew barber, who also acted as the physician in that district, came to shave Ibrahim: this Jew had often recommended to him some of his medicines, but Ibrahim always refused to take them. He again recommended them in my presence, with assurances that he would relieve him, if he confided in his treatment. Ibrahim at last, by my persuasion, took his medicine, which was prepared in my presence, and which, on examination, I found to be of a mushroom tribe, and the inner bark of the Sambucus Ebulus, which grows every where wild in that province; and, surprising to state, in a few hours, after a copious evacuation by vomiting, stool, and urine, the swelling and inflammation almost disappeared, and the very next day he walked in the room without help. From the Jew's description, I could not discover to what tribe this mushroom belonged, as it was in a dried state, and in the winter time; but in the following autumn it was pointed out to me, when I found it to be the Lycoperdon Bovista. On farther researches, I have ascertained that there are two sorts of Lycoperda medicinally used in agues, dropsies, and arthritic complaints. The use of the Lycoperdon Bovista, however, is more prevalent, being more common; the other sort grows only in the district of Pobereze, in the birch forests; it is called there Berezena trufla, Belaja trufla, that is birch-truffle, and white-truffle. I believe this species is unknown to any botanist, at least I have not found it any where except in the province called Pobereze. The roots are not unlike the Helianthus tuberosus: in flavour it is not unlike the Lycoperdon tuber, but rather pungent, and very bitter when eaten raw: by boiling, however, it generally loses this acrimonious taste; but in some seasons it is not eatable at all; and even much boiling, with changes of water, will not

avail to deprive it of its noxious and bitter quality. It must, at the same time be remarked, that in such seasons all the mushroom tribe are considered by the inhabitants unwholesome; even the favourite species, which grows only in the pine forests, called Ridzky Agaricus deliciosus, is poisonous. Count Michael Mossakowski was the first who introduced this species of truffle to the celebrated Count General Szczesny Potoczky's table, at Fulczyn; and two years after, this nobleman and myself nearly fell a sacrifice to eating some of it in a raw state, and we were saved from an almost instant death, only by drinking of sour milk. It had on us both the same effect, which was similar to the symptoms produced by chewing tobacco, a pinching in the bowels, and violent retching: fortunately for us it was in a village where sour milk was procured immediately. This Lycoperdon grows only in the district of Pobereze, in the Ukraine, and is commonly found at the depth of three or four inches under ground, in the month of July and August; those which make their appearance in July, are preferred for medicinal purposes, being of a milder quality: later in the season they get quite rank bitter. There is not a family in this district and its neighbourhood that is without it. The inhabitants cut it, slice it, and dry it in the shade, until the watery particles are evaporated; they then put it in an oven, after their bread is baked, till it is quite dry. The inhabitants, as I have before observed, use it as they do the Lycoperdon Bovista, in agues, dropsies, and arthritic complaints. Their method is this—they take a pinch of the fresh inner bark of the Sambucus Ebulus, and boil it in half a pint of water, or thereabouts, 'till it is reduced to a gill; they then take as much of the Lycoperdon, in powder, as will cover the point of a knife (I suppose from two to three grains), which they put into the decoction of the Sambucus over night, and next morning the patient takes half of this mixture. The effects are different in different constitutions; in some it produces nausea only; in some nausea and purging; in some violent perspiration; and others are much swollen; the pulse gets very low, hardly perceptible; the whole body chilled, and the patient becomes almost lifeless. In this case a second dose is given, which usually terminates in vomiting and purging, and the patient falls asleep for many hours. I have seen some that have slept twenty, and the whole time, in a violent perspiration; on waking, he asks commonly for drink; new milk is then given copiously; in agues, however, no milk is allowed: Barszez and Kivas is the drink in such cases. The former is made of beet-root, or its leaves, immerged for a few days in water, till they get sour; the latter (Kivas) is coarse flour and water, kept till it has become quite sour. The Barszez is considered as the most pleasant beverage. In case too large a dose of the mixture has been administered, the oil of the beech-nut is given, which stops the retching instantly, and afterwards a glass of whiskey as a cordial. In the province of Volhynia, the inhabitants make use of the Boletus Covinus, called Kamennoy Gryb. I have seen administered a decoction of this mushroom

in agues; a little verdegris is produced from a few kopeks, or copper-pieces, which the inhabitants besprinkle with vinegar over night, to draw the verdegris, which they use instead of tartar emetic, after which the decoction is given. I have, however, seen consequences of a serious nature arise from it, such as distortion of the limbs and paralysis, which I have attributed solely to the verdegris, for the mushroom is perfectly innocent in a dried state. This mushroom is also given in sterility and impotence, and it is much safer than cantharides, &c. &c.

As the Lycoperdon Bovista is not the production of every autumn, and as it loses much of its medical virtue in a dried state, especially if kept too long, the inhabitants frequently use, with much success, the inner bark of the Sambucus Ebulus alone, in the complaints to which I have before alluded.

No. XXXIII.

On Weeding or Cleaning Land. By George Rennie, *Esq. of Phantassie.*

WEEDS ought to be considered as robbers, that pilfer the food necessary for supporting the more valuable and useful vegetables. Viewed in this light, certainly all possible means for destroying them ought to be used; and if their total extirpation from the soil cannot be accomplished, their propagation should, at least, be checked, and their numbers diminished as much as possible. The weeds most commonly met with in this country are, 1. Couch grass; 2. Knot, or nut-grass; 3. Dockins, or dock-weed; 4. Thistles; 5. Tussilago, or colts-foot; 6. Crowfoot; 7. Nettles; 8. Rag-weed; 9. Mugwort; 10. Mountain-daisie, a species of the white gowan; all of which may be considered as perennials. The principal annuals are, 1. Scelloch, or crop-weed; 2. Wild-mustard; 3. Spurry, or rhums; 4. Annual white gowan; 5. Goose-grass; 6. Dornel; 7. Popple. To destroy these, and other noxious weeds, the operations of summer fallowing, horse and hand-hoeing, with hand-picking, are commonly employed, though often with less effect than might be expected. The object of this paper, therefore, is to illustrate the nature of these weeds, and to explain the best modes of removing them; matters certainly of great importance to the practical husbandman, though hitherto too much neglected in many places.

1. Perennial Weeds.

1. *Couch-grass.* This variety of grass, the most inveterate enemy of every farmer, requires no description, being well known from one end of the island to the other. To keep land free of it requires unremitted care and labour, though it may be effected by frequent ploughings in the summer months, harrowing and rolling repeatedly, and, above all, by gathering with the hand every particle of couch that is brought to the surface after the several ploughings. Attention to these operations must never cease, otherwise the enemy will soon be restored to his primitive strength; but, if constantly bestowed, the labour of each rotation

will gradually become more easy in the execution, and the expense thereof be proportionably diminished.

2. *Knot-grass.* This is a most baneful weed, and more difficult to be extirpated than the preceding one. It is called knot or nut-grass, from the roots of the plant resembling a parcel of nuts fixed together, of different sizes. When this parcel is separated by harrowing and rolling, the single nut will lie upon the surface, exposed to the severest drought, for many weeks, without losing its vegetative powers; and, when moistened by rain, or ploughed into the ground, will instantly grow again with as much vigour as if it had not been disturbed. In fact, there is no remedy against its pernicious effects, but carefully gathering the most minute fragment of the nut. Knot-grass also carries a large quantity of seed; so that no field, of which it is once in possession, can possibly be cleared without the steadiest perseverance of a farmer for many years.

3. *Dock-weed*, or *dockins.* This abominable weed is very prevalent in many districts, and is a most troublesome enemy upon all wet soils where it once gets footing. It propagates both by root and seed; the latter of which is produced in such abundance, that one stalk is sufficient to furnish seed for an acre. Many negligent farmers, when cutting their crops, allow the docks to stand, which is a most shameful and pernicious practice; as by the first gale of wind the seeds of the standing docks are blown over the whole field, to their great loss in after seasons. The only sure method of getting quit of docks, is to pull every stalk that can be discerned during the summer months, especially at those times when the ground may have been moistened by rain, and to separate any that may still remain, from the corn at the time of cutting; after which the whole may be removed to the end of the field and burned. If the ground is not so wet in summer as to admit the pulling of docks by the root, they ought, at all events, to be cut over, which will prevent a fresh increase of plants from the seed for that season.

4. *Thistles,* though common enough on all old grass-lands and pastures, are now kept within moderate bounds upon all well cultivated farms. Of this weed there are three varieties, viz. The rough, or common thistle; the bear, or big thistle; and the soft, or swine-thistle. The same cure will answer for them all, namely, good ploughing and regular fallowing, care being taken at the same time to cut and carry off any straggling plants that may happen to be among the corn

crops, so as fresh seeds of this weed may not be sown. Old grass lands of every description, and road sides, ought also to be annually cut with the scythe: a practice not so much attended to as it deserves.

5. *Tussilago*, or *Colts-foot*. This root is very hurtful to all lands under tillage when it once gets a footing, and till lately was considered as a weed which could hardly be exterminated. It flowers early in April, and sheds its seeds in the end of that month, or first of May, according to the state of the weather, always keeping as much earth about its roots as enables it to remain in life in spite of ploughing and harrowing. Gathering the flowers has been resorted to as the means of extirpation; but, as this weed continues to blossom every day for weeks together, the practice was found ineffectual. The writer of this paper, after combating this pernicious weed for thirty years, at last stumbled upon a remedy equally simple and efficacious, which is, to pull up the roots or stocks immediately after the corn is cut, at least as soon after as conveniency will permit. Upon examination it will be found, that around the neck of the stock, or root, within an inch of the surface, there is a parcel of buds about the size of a pea, from which in the spring the flowers, and of course the seeds, are produced. By pulling up the roots, therefore, which at that season is easily accomplished, the whole seed is at once destroyed. The best method of performing this operation is as follows: Put a number of boys or girls under the charge of a careful overseer, furnishing each of them with a small piece of iron, about the size of a boy's little finger, split up, like the toes of a hammer, at one end. By means of this simple implement, the root will be easily extracted, at least to the depth of the buds, in the event of its breaking above them when drawn by the hand. The roots must then be taken to a place of safety and buried; for, if laid on the sides of roads or stone walls, they will flower in the ensuing spring in spite of all the rough treatment received in the digging process. If this plan be carefully followed for two or three years, success may be depended upon. It would, however, be proper in the spring season, carefully to look over the lands thus treated; and, should either flower or root make their appearance, let it be pulled and carried off immediately.

6. *Crow-foot*. This weed, from its yellow flowers, is called *butter-cup* in England, the vulgar believing that it not only gives colour, but also adds to the quantity of butter, though this idea appears to be founded upon mistake. It

abounds in all old meadow grounds, and is eaten by cattle in the early part of the season, when tender and young; but, after it flowers and seeds, no animal will taste it. Crow-foot also prevails in wet tillage-lands, and has the effect of binding the soil so close, as almost to prevent the growth of corn. As it requires much rolling and harrowing to make it separate from the earth, it can only be effectually eradicated during the process of summer-fallow, when it ought to be carefully picked and burned.

7. *Nettles.* There are three sorts of nettles which infest the ground, viz. the common nettle, that grows about old buildings, stone walls, and upon old rich pastures. This is a perennial plant, and can easily be got quit of by pulling it in wet weather by the hand, covered with a strong glove, an operation performed to the greatest advantage when the plant is in flower. The other two sorts are annuals; one of them, called *day-nettle*, is rarely seen in old tillage land, but frequently appears in fields newly ploughed from grass, especially if recently limed; the other grows in gardens and on rich pieces of ground, but the injury from it is of small consequence.

8. *Rag-weed.* This weed makes its appearance in grass-lands, and may be kept down by sheep, if put upon it early in the season. If allowed to get into full growth, no animal whatever will taste it; therefore, under that circumstance, the best way of destroying this weed, is to cut it over before seeding, provided it cannot be pulled up by the root, which assuredly is the most effectual method.

9 and 10. *Mugwort* and *Mountain-daisey.* The same means may be used with success and effect in the extirpation of these weeds, as are directed for the extermination of *dock-weed* or *dockins*.

2. Annual Weeds.

1. *Scelloch*, or *crop-weed.* Of all the seed-weeds known in Scotland, this seems to be the most pernicious, occasioning immense labour to the farmer, and lessening the crops which he cultivates. This weed is to be found in greater or lesser numbers in all dry soils, particularly those which have been long cultivated; and so amply stocked does the soil appear to be with its seed, that though the weeds may be thinned and lessened from year to year, it seems physically impossible to remove them altogether. The scelloch, or crop-weed, has a small root, which it puts pretty deep into the ground; and its leaf, when about the size of a cabbage-

plant leaf, so much resembles that of a young turnip, that the one is often mistaken for the other. In the progress of its growth, which is very rapid, it puts out a middle stem, on which the flower is produced, and keeps growing to a considerable size, robbing and almost starving every other plant within its reach. It carries an immense quantity of seed, which is enclosed in an oily husk, and will, when lodged at a certain depth in the earth, out of the influence of the sun and air, preserve its vegetative powers for many years.

2. *Wild mustard.* This weed is more nice in its choice of soil than the last mentioned one, preferring rich dry gravels and loams, though often met with also upon clay soils which are in high condition. It is by no means so injurious as the scelloch, or crop-weed.

3. *Spurry*, or *rhums*. This kind of weed does not branch out like the two former ones, having seldom more than one stalk, and puts forth a yellow flower, not unlike that of wild mustard, from which a pod is formed for the seed, in shape somewhat resembling a louse. This variety is neither so numerous nor hurtful as the two already spoken of, though, to a certain extent, its effects upon corn crops are mischievous.

4. *Goose-grass.* This species of grass grows chiefly among wheat, and resembles a stalk of oats very much. Forty years ago it was very prevalent in Scotland, but is now seldom seen. The best method of getting free of it, is to sow clean seed, and to take care that no chaff, wherein is the least mixture of goose-grass seed, be thrown upon the dunghill.

5. *Dornel.* This variety of weed appears somewhat like a stalk of rye-grass, and is found chiefly in barley-fields. The observation given with respect to the best method of getting free of goose-grass, applies to dornel also. Some other weeds, such as those called *Cock-combs*, *Blue Blaverts*, *Gowans*, &c. &c. might have been mentioned; but as the cure for all annuals is the same, it seems unnecessary to notice them.

It remains now to speak of the most appropriate methods of keeping annual weeds within bounds, as their complete extirpation can scarcely be expected; and these may be confined to two measures. First, to bring the seeds in the ground within the limits of vegetation; and, secondly, to destroy every weed that vegetates, and thus gradually lessen the original stock.

In the first place, as the seeds of annual weeds are furnished with the means

preservation while stored in the ground, it is absolutely necessary to bring them into life before their destruction can be accomplished. This consists in ploughing, thereby bringing the seeds to the surface, or so near to it as that vegetation will take place, which process may be hastened by harrowing and rolling the ground, till it becomes soft and reduced. In this way the seeds within two or three inches of the surface may be expected to vegetate according to circumstances, such as the richness of the soil, the fineness of the mould, and the degree of moisture which may prevail when the above processes are executed.

In the second place;—when the first crop of weeds appears above the surface, a second ploughing should be given, by which that crop will instantly be destroyed, and a foundation laid for producing another. Harrowing and rolling should again be resorted to; and in this way several crops may be annihilated, especially in moist warm seasons, before turnips are drilled. When under that crop, both the hand and horse-hoe should be constantly employed whenever weeds appear; and upon no account should a single one be allowed to run to seed. By paying due attention to these matters, many farms which, not forty years ago, were a nest of seed-weeds, have now been brought into order, that is to say, the weeds are kept under subjection and easily managed.

To assist in these measures, it may even be necessary to hand-weed spring-crops of corn in many instances, and also to bestow diligent attention upon cleaning beans, lest one year's seeding, according to the old adage, should afterwards cause many years weeding. It is obvious that, by such attention, a considerable diminution in the number of weeds must annually take place, till at last these robbers of the soil be brought into such complete subjection, that no regular and steady farmer need be under much apprehension of any bad consequences to his crops from their attacks.

Before concluding this paper, it may be proper to state, that it would be of singular advantage to agriculture, were some general rules and regulations formed with regard to cutting and destroying weeds, especially those whose seeds are blown by the wind, and of course dangerous to the whole neighbourhood. That much and serious injury is often committed in that way is unquestionable; therefore, in my humble opinion, either some general law should be enacted upon the subject, or a clause or clauses be engrossed in every lease, binding and obliging

the tenant to pull, cut, and destroy thistles, docks, and all weeds whose seeds are apt to be driven about by the wind, to the annoyance of others. The proprietors or tenants of all old grass-lands should likewise be obliged to destroy thistles, &c. every year; and the like obligation should be laid upon tenants adjoining to the sides of roads, where weeds are often suffered to stand and shed their seed, to the manifest detriment of improved husbandry.

No. XXXIV.

On the Culture of Carrots. By Robert Burrows, *Esq. of Weasingham, near Rougham, in Norfolk.*

To the President of the Board of Agriculture.

Sir,

Learning from your letter to me of the 5th ultimo, that the Members of the Board of Agriculture are desirous of a further communication on the subject of my culture of carrots, and that they wish to be informed of the produce, together with my method of consuming my crop of last year, I can truly say that I have very great pleasure in complying with the wishes of the Board, not only on the present occasion, but I should have equal satisfaction, at any future period, in transmitting, for their information, any part of my practical husbandry, if I could for a moment consider there were any circumstances therein deserving their notice, or that it might contribute in the smallest degree to the interests of that public, which the truly patriotic members of your honourable and useful Institution are so indefatigable and so zealous in promoting.

From the particular circumstance of the total failure of my hay-crop, occasioned by the severe and long continued drought of last summer, I was obliged to have recourse to my carrots, as a substitute for that so necessary an article in the winter maintenance of horses, as hay; as such, I was prevented from applying my carrots, as I had originally intended, to the fattening of bullocks and sheep, with a view of ascertaining in what proportion they were superior to those roots generally resorted to for the purposes of winter-grazing, particularly the common turnip.

Thus diverted from my first intention by the powerful operation of necessity, my experiments, in feeding with my last year's crop, will not assume that novel and interesting appearance it is probable they might otherwise have done, had I been enabled to have prosecuted my designs; still I consider there are in my last year's consumption of my carrot-crop, some features of peculiar interest to

carrot-grower, and not entirely undeserving the attention of the Board of Agriculture.

It will be remembered, that in my former account of experiments, in feeding horses with carrots, and which I had the honour of transmitting to the Board, my principal object was then directed to the saving of oats, and that I never withheld from my horses whatever quantity of hay they chose to eat along with their carrots; but I then found from repeated experiments in thus feeding my horses, that they neither would nor could eat any thing like the quantity of hay consumed by horses fed in the usual way upon hay and oats only.

After having shown the above, what an important species of economy is it further to introduce to the attention of the agriculturist, and to that of the community at large, the possibility, founded on actual trial made, of keeping twenty-eight hard wrought cart and team horses, the greater part of a winter, without one handful of hay, and with only the smallest portion of oats imaginable, not more than one quarter of a peck per day each horse, and that merely to induce them to eat a sufficient quantity of dry food to keep their bodies in a firm and healthy state? The dry food given was cut barley-straw; the quantity, together with that of the oats, will be shewn in the sequel.

To obviate any objections, or to do away any doubts respecting the merit of carrots as a food for horses, founded on the supposition that the work performed by horses so fed may be light and easy, I think it right here to observe, that the labour on my farm last winter was unusually severe, particularly during the time the carrots lasted. A large proportion of the soil, which came under cultivation last winter, consisted of a strong tenacious loam, which had long been suffering neglect and impoverishment, and which, consequently, required much cultivation and improvement; such as deep ploughing, claying, and fetching manure from a distance: I had likewise to carry out my grain to a market sixteen miles distant, and to collect together, from almost as great a distance, materials for extensive farm-buildings to be erected in the spring. I mention these little minutiæ to prove that horses so fed, are capable of performing the hardest labour on a farm, provided they are properly attended to, and well looked after by those who have the care of feeding them; the prejudices of that class of farm-servants, who have the care of horses, are strong against carrots as a food, because they occasion more trouble than oats; for in wet weather, carrots, particularly when grown upon

adhesive soils, require a good deal of cleaning, or wiping off the dirt from them, before they are given to the horses to eat; nor should they be given to horses when wet, but should first be allowed to dry; for when wet, they spoil any other food that may be mixed with them, such, for instance, as cut-straw, or barn door chaff, into which carrots may be sliced, and horses will then eat the chaff or straw so mixed with the greatest eagerness; besides, if carrots are too frequently given to horses when wet, they are apt to prove laxative. These little attentions being necessary in feeding with carrots, servants consider the trouble occasioned thereby sufficient cause for them to throw in the way every obstacle in their power, to prevent the use of them answering their master's expectation.

With disadvantages of this nature, which, perhaps, in many instances have had their operation, by preventing carrots from being more generally used by farmers as a food for horses, still I am glad to perceive they are gaining ground over prejudice; and have great pleasure in learning, there are this year a number of acres sown amongst my immediate neighbours, with a view of applying them next winter as a food for their farm-horses; and I have not a single doubt but they will be fully satisfied with the result of their respective trials. At a time like the present, when agricultural products are selling at a price far below par, and manual labour has risen to a rate unprecedented, it highly behoves the farmer to cut off from his expenditure, every superfluous expense, and strictly to economise in every department of his outgoings, not immediately connected with the absolute manuring and improvement of his soil; if not, he will soon find that the charges and expenses of a farm will only bear such proportion to the value of its produce as will soon convince him that husbandry, from having been a pleasing and profitable occupation, will now be found one of the worst employments in the kingdom for a considerate man to embark a capital in.

There will be found connected with this account, as far as it goes, the detail of an experiment in feeding bullocks on various kinds of food, in which the superiority of carrots, over four different kinds of food, will be strikingly apparent. I regret that untoward circumstances, I did not altogether foresee, would not allow me to complete the experiment; but should circumstances prove favourable, I shall another year resume that part thereof, which promised to afford the most useful information in the result. Without further observations, I shall now proceed to give an account of the expense of cultivation, and mode of consuming my

16 acres of carrots grown last year; which indeed, considering the state and condition of the land, may be called a fair average crop.

Expenses of cultivating 16 acres of carrots, at Weasenham, in the county of Norfolk, upon a wheat-stubble, after peas; preceded by two years grasses. The soil a deep gravelly loam, except about four acres of the field, which consists of deep sand, rather inclined to black. Began sowing the 3d of April 1810. Seed 10 lbs. per statute acre.

	£.	s.	d.
Rent of land, including rectorial tythes - - - -	16	16	0
Vicarial tythes - - - -	2	0	0
Parochial rates - - - -	1	12	0
Ploughing the land four times, it being actually a bed of twitch-grass, 7*s.* per acre each ploughing - - -	22	8	0
Scarifying three times, at 1*s.* per acre each time - -	2	8	0
Various harrowings, a pair of horses and a lad 10 days, at 7*s.* per day	3	10	0
Women raking and burning the twitch - -	0	18	0
Rolling three times - - - -	0	12	0
Manuring 14 loads per acre of farm-yard manure, valued at 5*s.* per load - - - -	56	0	0
Spreading manure - - -	1	4	0
Seed, 10lb. per acre, at 1*s.* per lb. - -	8	0	0
Sowing - - - -	0	16	0
Harrowing in the same - - -	0	8	0
Hoeing 3 times, at 12*s.* first time, 10*s.* second, and 8*s.* 6*d.* last time	24	8	0
Taking up with three-pronged forks, at £1. 1*s.* per acre -	16	16	0
Carting home some of work done at odd times by the carters themselves for their own horses:—the rest of the expense amounted to, for the 16 acres - - - -	12	17	9
Interest upon capital employed - - -	8	10	7
Expenses of cultivating 16 acres of carrots	£179	4	4

Or per acre £11. 4*s.* 0¼*d.*

Produce of the 16 acres, 8096 bushels, or per acre 506 bushels.

Weighed the 15th of December, 1810, without their tops, 11 tons, 16 cwt. 2 qrs. 12 lbs. per acre, ascertained in manner following: Accompanied by the

Rev. St. John Priest, Secretary to the Norfolk Agricultural Society, and other persons who assisted at the weighing thereof, measured in four different parts of the field, eleven square yards in each place; weighed the produce of each, and found their average, when multiplied by 40, gave the before mentioned quantity as growing upon an acre of land; 11 square yards being exactly the 40th part of a statute acre.

Here I cannot refrain from stating, though not immediately connected with the subject, the weight per acre (ascertained in the same manner, on the same day, at the request of the before named gentleman) of a crop of Swedish, and one of common Norfolk white round turnips.

	tons.	cwt.	qrs.	lbs.
Swedish turnip per acre -	12	3	3	8
Common ditto ditto - -	11	17	2	0

The turnip crop last year, owing to the dryness of the summer, was indeed not an average one, which may, in some measure, account for these Swedes and common turnips weighing so much below what is generally stated, and supposed to be the weight of a good acre of turnips. However these were by no means despicable crops for any season, and I am convinced, if gentlemen and farmers would be at the trouble of weighing their turnip crops about the latter end of November (the time when turnips weigh heaviest) after the manner before described, they would by no means find them so heavy, or meet with that very great weight per acre they are generally estimated at. I have myself long been in the habits of weighing turnips grown upon the best soils of both this and the neighbouring county of Suffolk, but never met with an instance of more than 25 tons per acre. I would, indeed, go to a great distance to view such crops as I have heard the weight of, but never yet had the satisfaction of seeing.

N. B. The turnips, like the carrots, were weighed without their tops.

Application of Sixteen Acres of Carrots grown in 1810.

October 16th, began feeding 28 cart-horses with carrots, and continued them, without interruption, up to the 5th of February following, when I discontinued the use of them in my cart-horse stables, as I wished to preserve the remaining part of my crop for my saddle horses. Thus 28 horses were fed upon carrots 16 weeks, at an allowance each horse of two Winchester bushels per day, to which allowance were added one quarter of a peck of oats for each horse, found necessary

to induce him to eat his full proportion of cut barley-straw, 6 pecks of which were measured off for each horse per day, and given part with the carrots in the course of the day; the rest had the few oats mixed therewith at night for each horse; or about the same quantity of chaff from the barn, when the latter could be procured, which the horses always preferred to the cut straw.

	a.	r.	p.
Twenty-eight cart horses 112 days, at two bushels of carrots each horse per day, is 6272 bushels, or the produce of -	12	1	23
Twenty-eight horses 112 days, at one quarter of a peck of oats each horse per day, makes 196 bushels, or the produce of -	4	0	13
	16	1	36

Thus having proved the quantity of land necessary to maintain twenty eight cart-horses, fed upon carrots sixteen weeks, or 112 days, I shall now proceed to show likewise the quantity of land required to feed the same number of horses upon hay and oats, for an equal number of days; then, by estimating such hay and oats at their market value, will be shown the worth of my carrots per acre: besides proving the quantity of land so saved to the community.

	a.	r.	p.
Twenty-eight cart-horses 16 weeks, or 112 days, at 2 stone per day each horse; or $1\frac{3}{4}$ cwt. per week, gives 1 ton 8 cwt. of hay for each horse, or for the 28 horses, 39 tons, 4 cwt. or the produce of	26	0	22
Twenty-eight cart-horses 16 weeks, or 112 days, at one peck of oats per day each horse, is 98 quarters, or the produce of -	16	1	13
Quantity of land required to keep 28 horses upon hay and oats 16 weeks - - -	42	1	35

Here appears a saving to the public of 25 acres, 3 roods, 39 perches of land in keeping 28 horses only 16 weeks. I shall now proceed to estimate the value of the above quantities of oats and hay as under.

	£.	s.	d.
39 tons, 4 cwt. of hay, at 5*s.* per cwt. - -	196	0	0
98 quarters of oats, at 28*s.* per quarter - -	137	4	0
Value of the produce in hay and oats necessary to maintain 28 horses 112 days - -	333	4	0

To show the value of the carrots in the clearest manner, I shall proceed in deducting from the £333. 4*s.* (the value of the oats and hay, it would have

required to have kept the same number of horses the same length of time), the worth of the 196 bushels of oats eaten by my 28 horses whilst at carrots; the sum that remains being £298. 18*s.* is the value of the 6272 bushels of carrots; or per bushel 11¼*d.*; or per acre a trifle more than £23. 14*s.* 4*d.* There now remain 1824 bushels to be accounted for, which will be found as under.

	£.	s.	d.
Given to four saddle horses one bushel per day each, from the 7th of October to the 29th of April, a period of 203 days, making 812 bushels, which, considering these horses had likewise to live without hay, I cannot do otherwise than value the carrots at the same price the cart-horses paid for them, 11¼ per bushel -	38	1	3
Fed two Highland Scotch bullocks (an account of which will be annexed) six weeks, in which time they gained 194½ lbs. of beef, at 9*d.* per lb. amounts to something more than 7½*d.* per bushel for the carrots, or for 228 bushels eaten - -	7	5	10¾
Sold to my different neighbours, at their earnest request, and with a hope that a knowledge of the value of carrots might induce them in future to cultivate them for their own use, 710 bushels, at 1*s.* per bushel - - - -	35	10	0
	80	17	1¼
Add the value of the 6272 bushels, eaten by my cart-horses	298	18	0
The value of 16 acres of carrots	£379	15	1¼

Recapitulation.

		£.	s.	d.
6272	bushels eaten by cart-horses, paid per bushel -	0	0	11¼
812	bushels eaten by my saddle-horses, to be reckoned at the same price - - - - - -	0	0	11¼
228	bushels eaten by bullocks - - -	0	0	7½
710	bushels, sold at 1*s.* per bushel - -	0	1	0
8022	10½*d.* average per bushel.			

There remain 74 bushels to be accounted for, which I suppose were consumed in the family, and wasted in measuring them over a second time.

I shall now give the detail of an experiment in feeding ten Scotch Highland bullocks six weeks, upon five different kinds of food, of which carrots formed

one; and as such this account necessarily claims connection with the foregoing: the carrots consumed by these bullocks forming part of the crop of the 16 acres.

January 1st, 1811, weighed alive, after 18 hours fasting, ten Highland Scotch bullocks; found their weight as under, in stones of 14 lbs. to the stone.

Lot 1.

No. 1.	1 weighed	52 stone 5 lb.	These were put to common turnips.
	2 ——	46 ditto 0	

Lot 2.

No. 2.	3 ——	48 ditto 3 do.	These at Swedish turnips.
	4 ——	46 ditto 4 do.	

Lot 3.

No. 3.	5 ——	49 ditto 6 do.	These at mangel wurzel.
	6 ——	50 ditto 7 do.	

Lot 4.

No. 4.	7 ——	53 ditto 1 do.	These at carrots.
	8 ——	47 ditto 0 do.	

Lot 5.

No. 5.	9 ——	47 ditto 3 do.	These at molasses.
	10 ——	53 ditto 11 do.	

Tied them up by the head; their food was given them in small regular portions, to prevent as much as possible any waste being made. No hay was intended, as the experiment was solely and with the view of *absolutely* ascertaining the comparative value of the respective kinds of food in fattening animals; as I have frequently witnessed experiments conducted with this or that article of food, and which was reported fully to have answered the experimenter's intention in fattening his cattle, when at the same time it was no difficult matter to perceive, that the benefit received by the animal so fed, was principally derived from the excellent hay given along with the food, whose reputation, as a fattening article, has so been established upon the foundation of such vague experiments.

Not wishing to be deceived myself, and having no inclination to mislead others, I chose to rely entirely upon the intrinsic merit of each variety of food itself, that I might be enabled to discover in what proportion they possessed those nutricious properties, necessary to the nourishment and production of flesh in animals. As such I thought proper to dispense with the use of hay, and to substitute in its

room barley, or oat-straw; sometimes one and sometimes the other, was cut into chaff for the bullocks fed on molasses, and the others had a small quantity given them in their racks at night, not exceeding 5 lbs. in weight: sometimes it was all eaten by the morning; at other times it was not. When the latter happened, the remaining straw was taken out of the rack, and occasionally in the course of the day was given to them again, and this was usually consumed before night; so that, upon the whole, the bullocks fed on turnips, &c. ate their 5lbs. of straw per day during the time they were at this experiment; the rest of the food given was as under:

LOT 1.

		lbs. wt.	
Nos. 1 and 2. First week. Weather frosty.	1 day	424	Took away offal 37 lbs. weight.
	2 ditto	424	
	3 ditto	424	
	4 ditto	424	
	5 ditto	424	
	6 ditto	424	
	7 ditto	424	
		2968	
Do. Second week. Severe frost; food froze in the manger so as to require bruising or breaking.	1st Day	424	Took away offal 39 lbs. weight.
	2. Do.	424	
	3. Do.	424	
	4. Do.	424	
	5. Do.	371	
	6. Do.	318	
	7. Do.	371	
		2756	
Do. Third week. Frost breaking up, the weather somewhat mild, so as the bullocks could eat their food without assistance.	1 day	424	Took away 31 lbs. of offal.
	2 ditto	477	
	3 ditto	477	
	4 ditto	371	
	5 ditto	477	
	6 ditto	371	
	7 ditto	424	
		3021	
Do. Fourth week. Weather mild.	1 day	530	Took away offal 29 lbs. weight.
	2 ditto	424	
	3 ditto	530	
	4 ditto	424	
	5 ditto	424	
	6 ditto	477	
	7 ditto	212	
		3021	

At the end of the month the two bullocks had eaten 11430 lbs. weight of common turnips, when they were weighed after 18 hours fasting.

LOT 2.

		lbs. wt.	
No. 3 and 4. First week.	1 day	285	Took away offal 17 lbs. weight.
	2 ditto	285	
	3 ditto	285	
	4 ditto	285	
	5 ditto	171	
	6 ditto	228	
	7 ditto	342	
		1881	
Do. Second week.	1 day	285	Took away 25 lbs. weight of offal.
	2 ditto	287	
	3 ditto	399	
	4 ditto	285	
	5 ditto	285	
	6 ditto	342	
	7 ditto	342	
		2225	
Do. Third week.	1 day	285	Took away 16 lbs. of offal.
	2 ditto	456	
	3 ditto	228	
	4 ditto	228	
	5 ditto	342	
	6 ditto	342	
	7 ditto	228	
		2109	
Do. Fourth week.	1 day	342	Took away offal 12 lbs. weight.
	2 ditto	399	
	3 ditto	228	
	4 ditto	287	
	5 ditto	287	
	6 ditto	287	
	7 ditto	399	
		2229	

These ate in the month 8374 lbs. weight of Swedes; when they, after the like fasting, were weighed with the turnip-fed bullocks.

LOT 3.

Nos. 5 and 6. First week.	1 day	137	Took away offal 19 lbs. weight.
	2 ditto	137	
	3 ditto	201	
	4 ditto	201	
	5 ditto	137	
	6 ditto	201	
	7 ditto	201	
		1215	

		lbs. wt.	
Nos. 5 and 6. Second week.	1 day	201	Took away offal 11 lbs. weight.
	2 ditto	201	
	3 ditto	137	
	4 ditto	137	
	5 ditto	201	
	6 ditto	201	
	7 ditto	201	
		1279	
Do. Third week.	1 day	137	Took away offal 9 lbs. weight.
	2 ditto	274	
	3 ditto	137	
	4 ditto	201	
	5 ditto	201	
	6 ditto	201	
	7 ditto	201	
		1352	
Do. Fourth week.	1 day	201	Took away offal 7 lbs. weight.
	2 ditto	201	
	3 ditto	201	
	4 ditto	201	
	5 ditto	137	
	6 ditto	201	
	7 ditto	201	
		1343	

In the month they ate 5143 lbs. weight of mangel wurzel; they were weighed with the others.

LOT 4.

Nos. 7 and 8. First week.	1 day	270	Took away offal 9lbs. weight.
	2 ditto	270	
	3 ditto	324	
	4 ditto	270	
	5 ditto	162	
	6 ditto	216	
	7 ditto	216	
		1728	
Do. Second week.	1 day	270	Took away offal 15 lbs. weight.
	2 ditto	324	
	3 ditto	324	
	4 ditto	324	
	5 ditto	324	
	6 ditto	324	
	7 ditto	324	
		2214	

		lbs. wt.	
Nos. 7 and 8. Third week.	1 day	270	Took away 8 lbs. of offal.
	2 ditto	324	
	3 ditto	324	
	4 ditto	270	
	5 ditto	324	
	6 ditto	324	
	7 ditto	324	
		2160	
Do. Fourth week.	1 day	162	Took away 11 lbs. weight of offal.
	2 ditto	324	
	3 ditto	324	
	4 ditto	324	
	5 ditto	270	
	6 ditto	270	
	7 ditto	216	
		1890	

In the course of the month these bullocks were found to have eaten 7949 lbs. weight of carrots, they were then, after fasting, weighed with the foregoing.

LOT 5.

		lbs. of molasses.	lbs. of straw.
Nos. 9 and 10. First week.	1 day	7½	42
	2 ditto	10	49
	3 ditto	5	42
	4 ditto	5	42
	5 ditto	5	42
	6 ditto	5	42
	7 ditto	10	56
		47½	315
Do. Second week.	1 day	5	42
	2 ditto	5	40
	3 ditto	7½	40
	4 ditto	7½	42
	5 ditto	3	40
	6 ditto	7½	42
	7 ditto	7½	42
		42	288
Do. Third week.	1 day	5	40
	2 ditto	5	42
	3 ditto	5	42
	4 ditto	7½	56
	5 ditto	7½	56
	6 ditto	5	56
	7 ditto	7½	42
		42½	334

		lbs. of molasses.	lbs. of straw.
Nos. 9 and 10. Fourth week.	1 day	10	50
	2 ditto	10	42
	3 ditto	10	42
	4 ditto	5	40
	5 ditto	7½	46
	6 ditto	5	42
	7 ditto	7½	37
		55	299

Ate in the month 187 lbs. weight of molasses, and 1236 lbs. weight of cut straw: then weighed with the others.

After eighteen hours fasting, the ten bullocks were weighed, and their respective weights found to be as follows, January 29th, 1811, having been at feeding 28 days.

Nos.	Stones.	lbs.		Stones.	lbs.		Stones.	lbs.
1	54	4	gained	1	13	both together	5	13
2	50	0	ditto	4	0			
3	50	6	ditto	2	3	together	6	3
4	50	4	ditto	4	0			
5	53	3	ditto	3	11	together	5	1
6	51	11	ditto	1	4			
7	58	4	ditto	5	3	together	9	5
8	51	2	ditto	4	2			
9	47	0	lost	0	3	together	1	1
10	52	13	ditto	0	12			

RACAPITULATION.

1, 2 Ate 11430 lbs. of turnips; gained 83 lbs. of beef; at 9*d.* per lb. paid for turnips 3½*d.* per bush.

3, 4 Ate 8374 of Swedish turnips; gained 87 of beef; at 9*d.* per lb. paid for turnips 5¼*d.*

5, 6 Ate 5143 of Mangel Wurzel: gained 71 of beef; at 9*d.* per lb. paid for Mang. Wurzel 8¼*d.*

7, 8 Ate 7949 of carrots; gained 131 of beef; at 9*d.* per lb. paid for the carrots 8*d.*

9, 10 Ate 187 of molasses, with 1236 lbs. of cut straw; lost 15 lbs. of beef; which, at 9*d.* per lb.

	L.	*s.*	*d.*
Is for beef lost	0	11	3
Lost by molasses, 187 lbs. at 3½ per lb.	2	14	6½
Value of straw	1	2	0
Cutting ditto	0	4	0
Lost by bullocks at molasses in the first month	*L.* 4	11	9½

N.B. The Winchester bushel of carrots weighed 54 lbs.
Mangel Wurzel 67 do.
Swedish turnips 57 do.
Common ditto 53 do.

I here make a few observations on the foregoing experiment, such as occurred to me at the time. The weather was cold, and frost rather severe, at tying up the bullocks, consequently such commencement was unfavourable, particularly to the bullocks that were fed with turnips, &c. as it was with difficulty we kept the roots from freezing so hard, that the bullocks could eat them without the help of cutting or bruising them; however we managed pretty well throughout the month. This weather of course did not affect the food given to the molasses-fed beasts, yet it was with the greatest reluctance they would eat it; and this dislike to their food continued for the six weeks they were kept at it: notwithstanding they had plenty of water at hand, and within reach, sometimes they would drink a considerable quantity, and sometimes none in the whole day. The food appeared to agree very well with their constitutions, yet they never filled themselves, or looked well. If I had bought hay and given it to them, they would probably have eaten their food much better, and perhaps done well; but then I should have considered the benefit, so derived, to be owing to the hay rather than to the molasses themselves: if there had been any fattening qualities in the molasses, they must now here show themselves. I likewise here observe, that I continued these two bullocks two days, after the others were turned to bean-meal, and mixed the molasses up with coarse bran from the miller's, diluting the syrup as before with warm water; then let the bran dry before I offered it to the bullocks; in this way they would not eat it at all. The Mangel Wurzel beasts never took kindly to their food, nor would they eat a sufficient quantity to fill themselves; but the result of this food is satisfactory enough to require further trial therewith, some future opportuntiy.

Continued thus feeding until the 12th of February, when I found the severe frost had not only rotted the common turnip, but had likewise had such an effect on the Ruta-baga, as to render it spongy and tasteless. On cutting the roots, there appeared no longer that juicy firmness in the flesh thereof, which forms one of its principal characteristics; but they were dry and porous, nor did the bullocks eat them with the avidity they did before. This was the first time since I have been a grower of the Ruta-baga, that I ever perceived the frost to have an effect on them, but I have since learnt that several graziers in this neighbourhood observed the same thing last season, and found that the bullocks and sheep at keeping on them, in the language of the grazier, did nothing. The two kinds of

turnips having thus lost their saccharine qualities, which rendered them no longer fit for the purposes of fattening cattle, together with the still continued losing, as it appeared, of the two at molasses, induced me to discontinue the experiment, and to put the whole upon bean-meal, which I did on the 12th of February; but previous thereto, I wished to ascertain what they had done in the last fortnight.

February 13, 1811, after 18 hours fasting as before, weighed the 10 Highland Scots: found their weight to be as follows:

			stone.	lbs.		stone.	lbs.
Lot 1.	1	gained	0	13	both together	2	4
	2	ditto	1	5			
Lot 2.	3	gained	1	9	both together	3	2
	4	ditto	1	7			
Lot 3.	5	gained	0	9	both together	1	0
	6	ditto	0	5			
Lot 4.	7	gained	2	1	together	4	7
	8	ditto	2	6			
Lot 5.	9	lost	0	9	together	1	0
	10	ditto	0	5			

Ate in the Fortnight as under:

LOT 1.

		lbs. wt.	
Nos. 1 and 2. First week.	1 day	371	Took away offal 56lbs. weight.
	2 ditto	371	
	3 ditto	318	
	4 ditto	424	
	5 ditto	424	
	6 ditto	318	
	7 ditto	318	
		2544	
Do. Second week.	1 day	318	Took away offal 43 lbs. weight.
	2 ditto	318	
	3 ditto	318	
	4 ditto	371	
	5 ditto	371	
	6 ditto	371	
	7 ditto	424	
		2491	

These bullocks in the 14 days ate 4936 lbs. weight of common turnip; gained 32 lbs. of beef; paid for the turnips 3*d*. per bushel.

LOT 2.

		lbs. wt.	
Nos. 3 and 4. First week.	1 day	342	Took away offal 36 lbs. weight.
	2 ditto	342	
	3 ditto	342	
	4 ditto	228	
	5 ditto	228	
	6 ditto	228	
	7 ditto	228	
		1938	
Do. Second week.	1 day	228	Took away offal 93 lbs.
	2 ditto	228	
	3 ditto	228	
	4 ditto	228	
	5 ditto	342	
	6 ditto	228	
	7 ditto	228	
		1710	

Ate in the fortnight 3519 lbs. weight of Swedish turnips; gained 44 lbs. of beef; paid for turnips 6½*d.* per bushel.

LOT 3.

Nos. 5 and 6. First week.	1 day	137	Took away offal 18 lbs. weight.
	2 ditto	137	
	3 ditto	137	
	4 ditto	137	
	5 ditto	201	
	6 ditto	201	
	7 ditto	137	
		1087	
Do. Second week.	1 day	201	Took away offal 12 lbs. weight.
	2 ditto	201	
	3 ditto	137	
	4 ditto	137	
	5 ditto	137	
	6 ditto	137	
	7 ditto	137	
		1087	

In the course of the 14 days these two bullocks ate 2144 lbs. of Mangel Wurzel; gained 14 lbs. of beef; paid per bushel 4*d.* for the Mangel Wurzel.

LOT 4.

Nos. 7 and 8. First week.	1 day	270	Took away offal 12 lbs.
	2 ditto	270	
	3 ditto	270	
	4 ditto	270	
	5 ditto	324	
	6 ditto	324	
	7 ditto	324	
		2052	

		lbs. wt.	
Nos. 7 and 8. Second week.	1 day	324	Took away offal 12lbs. weight.
	2 ditto	324	
	3 ditto	270	
	4 ditto	270	
	5 ditto	324	
	6 ditto	324	
	7 ditto	270	
		2106	

Ate in the fortnight 4134 lbs. weight of carrots; gained 63 lbs. of beef: paid per bushel for the carrots $7\frac{1}{4}d$.

LOT 5.

		lbs. of molasses.	lbs. of cut straw.
Nos. 9 and 10. First week.	1 day	10	42
	2 ditto	10	40
	3 ditto	$7\frac{1}{2}$	42
	4 ditto	$7\frac{1}{2}$	42
	5 ditto	5	42
	6 ditto	10	42
	7 ditto	$7\frac{1}{2}$	42
		$57\frac{1}{2}$	292
Do. Second week.	1 day	10	37
	2 ditto	$7\frac{1}{2}$	42
	3 ditto	$7\frac{1}{2}$	42
	4 ditto	$7\frac{1}{2}$	42
	5 ditto	10	42
	6 ditto	$7\frac{1}{2}$	42
	7 ditto	5	42
		55	289

These two bullocks ate in the last fortnight $112\frac{1}{2}$ lbs. of molasses, with 581 lbs. weight of cut straw; lost 14 lbs. of beef, or in money, at $9d.$ per lb. for the beef, $10s.$ $6d.$ which, together with the value of straw and molasses, makes the loss $2l.$ $5s.$ $3\frac{3}{4}d.$

I shall now conclude this account, already, I fear, longer than it is either useful or interesting. I am sorry I saw no prospect of making the experiment more conclusive, which, under the circumstances that occurred, could not have been the case, if I had continued the experiment any longer than I did; but I see sufficient encouragement to enter upon the like, or something similar, another year; it is my intention then to add oil-cake, by way of comparing it with carrots,

which the present instance, joined with my former experience of that invaluable root, induces me to think the most fattening vegetable at present in cultivation, and possesses equally forcing qualities with any substance made use of by graziers. Enough, I think, has been shown to prove, that though they might keep animals alive, they are not calculated to produce flesh; however, perhaps, some gentleman, or farmer, may be inclined to give them a trial upon a different principle.

I did intend, in case I had continued the experiment throughout the season, to have kept the dung from each respective food by itself, and to have extended that to a farther experiment regarding the effects as a manure. I consider that as a most important point. Much has been asserted respecting the dung from oil-cake fed beasts; but I know of no steps that have been taken by any practical farmer to ascertain its qualities, compared in its effects with other manures. Much of profit, arising from any substance with which animals are fed, may certainly be fairly charged to the value of its manure, especially when it is considered of what importance manure is, on a farm distant from a large town or a navigation, and what expense good farmers are at annually in the purchase of substances entirely for the purposes of manure.

With all due respect for the Members of that Institution over which you so ably preside,

I beg leave to subscribe myself,

SIR,

Your obedient humble Servant,

ROBERT BURROWS.

SIR, *Weasenham, near Rougham, June 17th,* 1812.

I AM favoured with your Letters dated the 9th and 10th inst. and beg to say in answer, that I hope soon to have a leisure opportunity of transmitting to the Board of Agriculture, the result of my experimental attention to the culture of spring wheat.

Your Letter, enveloping the interesting extract respecting the cultivation of carrots, collected in the course of your enquiries regarding the husbandry of

Scotland, gave me indeed great satisfaction, to learn the culture of that valuable esculent is so well understood in that part of the kingdom: the ideas of those gentlemen who have there paid attention to carrots, in many instances accord with mine; I have added such observations as occurred to me whilst perusing the account; and which several years experience in the culture and application of carrots, will warrant me in recommending to the attention of such farmers as may be induced, by giving them a fair trial, not only to promote their own individual interest, but likewise the immediate and permanent interests of the community at large; by banishing from the general practice of rural economy, the barbarous and wasteful custom of feeding farming horses with grain.

I consider carrots to be the least difficult to raise of all the esculent plants; and the least trouble to preserve during the winter; their cultivation only want to be more general, and better understood; the mighty difficulties that are now deemed sufficient to deter farmers from attempting to cultivate them, would then vanish, and give place to a conviction of their superiour value as food for every description of cattle; and the consequent profit that would accrue to the grower from the home consumption of them, would establish their superiority over that of a crop of turnips; and thus set at rest for ever the question of comparison in every man's own mind. On all suitable soils, and in neighbourhoods where labour is plentiful, they ought always to have the preference to turnips; the latter are always a more uncertain, more tedious, and in almost all instances, a far more expensive crop than carrots. No fly, no black canker ever yet molested a crop of carrots; and when severe frosts cut off in one night whole crops, nay, whole districts of turnips, the carrots scarce sustain any injury from the severest seasons, owing to the close texture of the root itself; and from the circumstance of its being buried entirely under ground, the carrot is enabled to stand the severity of seasons much better than turnips; nor do they require the trouble to preserve, or are they of the perishable quality of potatoes, which advantage alone renders this otherwise excellent root an object deserving of general cultivation among farmers as a consumable article on their farms.

Provided the seed is good, and proper care and attention be paid to the first hoeing (which certainly in most instances is a tedious operation), the cultivator never need fear a good plant of carrots; and even without manure, a profitable crop: and supposing we admit the operation of hoeing the first time to be tedious

and expensive, the season usual for the work commences, and is even over, before the general summer business of the farm puts in requisition the numerous hands which, at that season of the year, are craving employment.

Certainly for working horses I know of no food equal to carrots; this present year my own farm was a striking instance of their superiority even over grain: by making too free with them for other purposes, my carrots this season were finished a month sooner than I intended they should; I was of course obliged to buy oats in lieu of them, at the high price of 30s. the coomb of 4 Winchester bushels; and though I allowed my 30 horses one peck of oats per diem each, with what excellent clover hay they would eat, yet still they fell off in flesh, in a truly striking and surprising degree; so much so, that even my servants who fed the horses, and who in the early part of the season murmured because they had not oats for their horses instead of carrots, now confessed their ignorance and error, and regretted the want of carrots sufficient to carry them through until the time of feeding with grass. I know of no department of husbandry in which the farmer is more deficient in the knowledge of his own interest, than in the mode of feeding his working horses, or of no one in which the prejudices of both master and servant are stronger: time only will afford a remedy for the evil; though much may be done in the interim, by the circulation of such well attested facts, as point out in the forcible language of self-interest, the immediate saving it would be to individuals, were they induced to adopt the more economical method of feeding team horses with carrots, or Swedish turnips, in lieu of oats or other grain: the prosperity and population of the kingdom would thereby be increased, in a proportion incredible to those who have not sufficiently reflected on the immense breadth of land required for the support of those animals, whose assistance we find requisite to enable us to till the whole. I could easily demonstrate, were I called upon, that half the quantity of land now appropriated to the maintenance of our working horses might be spared, and converted to the purpose of raising sustenance for the use of man; and instead of importing oats and wheat, we might, with the revision of our corn laws by the legislature, become an exporting, instead of an importing country.

I have tried drilling, but it did not answer; could find no means of distributing the seed regularly from the drill; nor can I see any advantage that would accrue therefrom, except saving a small portion of seed: the hoeing must equally be done by hand: the carrot plant, when it is first requisite to hoe the crop, being so weak

and delicate as not to admit an horse-hoe to approach near the plant; they would, in that case, be smothered with mould. It would have been right to have stated the expense of horse-hoeing an acre of carrots, and to have compared it with the expense necessary to clean an acre sown in the usual broad-cast manner. I speak here of drilling on flat or level surface-work. Where the carrots are drilled in rows, and the manure deposited in the furrows, after the Lothian system of row-cultured turnips, perhaps the expense of weeding the land might be diminished by having recourse to the horse-hoes: from the latter system of management I should have expected much greater crops. I am inclined altogether to think that the manure used for a carrot crop, might be applied with more advantage to other crops on a farm. Very profitable crops of carrots may be raised on suitable soils, without manure.

I find them much better left in the earth until such time as they are wanting for use; horses and bullocks eat them much better fresh out of the ground; only it is requisite where animals are wholly fed upon them, that a sufficient number are taken up to provide against long frosts and snows: likewise rainy weather makes them very troublesome for servants to clean and prepare for their horses: some servants are so lazy and careless, as to give them to horses covered with dirt. In that case, if often repeated, they injure the health of the animal, by producing bowel disorders; it is therefore necessary to take up in fine weather a sufficient quantity, and have them stacked, or put together in the field, which may be done at a trifling expense. I shall treat more fully of the method of doing it in my account of my last year's crop, which I intend myself the honour of laying before the Board of Agriculture so soon as I have arranged the necessary matter. In Suffolk, I am aware of the farmers sowing only the quantity of half the seed per acre that I do; but I had rather have plants to cut up, than not enough for a crop; besides, good loams require more seed than light sands; on the latter, every seed that is good is sure to vegetate, and but few weeds arise; whilst the surface of good soils is often coarse and cloddy, and many seeds are buried beneath the clods never more to see the light; and such weeds as are indigenous grow more rapidly on good lands; and where many weeds are expected, more seed should be sown, as, unavoidably, in extricating the carrots from the weeds, many of the former will fall a sacrifice to the hoes. I have seen large fields sown with carrots in the vicinity of Woodbridge, many parts of which wanted a full plant; I

attributed the cause to the farmer's not sowing a full seed; and upon conversing with some of the carrot growers there, I found them willing to admit that in general they are too sparing of seed.

The only way to insure good seed is for the farmer to grow it himself, which may be done by selecting some of the best shaped middling sized carrots, and transplanting them early in the spring, in some spare corner of the farm, or nursery, or young plantation, in rows of a good distance from each other, in order to admit, when the heads of seed begin to ripen, some persons going between the rows, to gather such heads as are already ripe, and lay them in some dry place until the whole crop is ready to thrash out. I consider the reason of so much light seed being found among that we buy, is owing to its being cut altogether, the ripe and the unripe; however, I never found any seed so good in respect to the purity, and quality of its produce, as that which I have saved myself. I never find so many seeded or runaway carrots amongst my own seed, not more than one to fifty, that I always do in a crop from the seed I purchase: hence the advantage of transplanted seed: what we purchase of the seedsmen being the greater part thereof saved from carrots without transplanting. Every turnip-farmer knows the value of transplanted turnip seed, which always sells for treble the price of such turnip seed as cannot be warranted; and as far as my experience goes, I have observed the same advantages attend nicely selected carrot seed. By growing it himself, the farmer will be certain of the stock and quality of his seed; and will at the same time, be enabled to supply himself with seed at less than half the price he must give for it to the seedsman.

I am inclined to think that autumnal ploughing increases the number of weeds; for in my crops of both the last and present year, I observed that part of the fields that were winter-fallowed, to be most infested with weeds. By winter fallowing, I mean ploughed up in October, and again twice before sowing, early in the spring. I used to think that green manure might, in some measure, increase the number of weeds among carrots; but my crops of both the last, as well as present year, were but parts of it manured for, and evidently this season the winter-fallowed part of the field abounds with weeds. Altogether, I think the best way is to plough the land up a proper depth immediately before sowing the seed, as in the early part of the spring, land seldom works better than it does directly after ploughing, and much labour is certainly saved by avoiding previous tillage. I had

an exception last year to this doctrine of once ploughing to avoid weeds, and that was six acres of turnip-land sown with carrots, with only once ploughing the same, and a greater number of weeds I never did see upon an equal space of land: but I think this may be in some measure accounted for, by the unusual depth the land was ploughed, not less than 13 inches; by this means I consider that the seeds of numerous tribes of weeds were brought to the surface, which might hitherto have lain dormant for years. I think this likely, as amongst them I observed several species that were not common in either that or the adjoining fields. I did not even, where the weeds were not quite so numerous, observe the carrots the better for the very deep ploughing, nor in general on soils suitable for carrot-culture, do I perceive the necessity of such very deep ploughing; for if the land is in what farmers call good heart, when the plants get strong and vigorous, if the subsoil is at all of a loose texture, there is no fear of the carrots finding their way downwards.

That carrots, by their leaves, do receive much nourishment from their absorption of sap, and nourishment from the numerous gases, which form food for plants, and which are more or less afloat in the atmosphere, I have no doubt; and as a proof of the advantages plants derive from a vigorous foliage, I beg to state what follows: I was induced, from having either seen it in print, or heard it observed, that carrots were benefited by mowing of their leaves in summer, which is said to increase the size of the roots, to set apart, in the summer of 1807, ten square yards for the trial; had them, that is to say the tops, cut carefully off without injuring the head of the root, twice in the summer; but having lost or mislaid the minutes I made of the experiment, I can only speak from memory of the result; but I perfectly recollect the first cutting to be the last week in July; and I remember the weight of the root at the time of taking up the crop in November, was not half so much as on the adjoining ten yards, that were allowed their natural course of growing.

I am satisfied that carrots can be grown with success upon peaty soils, having with pleasure observed, whilst living at Witchingham, in this county, the cottagers cultivate them in their gardens, which were taken off a peat moor. I have in several instances attended to their crops, and found them many times equal, and sometimes superior to my own crops grown on a fine sandy loam. I know two instances of cottagers upon 60 perches of land of this description, growing carrots sufficient to winter a cow; indeed I think it possible for cottagers upon very little more, nay

even an acre of land, by cultivating lucern and carrots, to maintain throughout the year that greatest of all comforts in a poor family—a cow. In an experiment I made with horses in the years 1807 and 1808, I fed ten horses the year through, upon the produce of 10 acres and 1 rood of land, by soiling them with lucern in summer, and feeding with carrots and lucerne, hay cut into chaff, in winter. If ten hard working horses could be so kept, and well fed on the produce of one acre of land each, surely a middle sized cottager's cow might be fed on the produce of an equal space of land.

In regard to the method of preparing the seed, I invariably abide by the practice of preparing it in moist sand, a fortnight or three weeks before sowing; and as I never yet wanted plants in the field, I think I should be wrong in deviating from a rule constantly attended with success. It is to be observed, that I always take care to have the seed sown close to the plough, and harrowed directly with a light pair of harrows.

The subject is so copious, that a volume could scarce suffice for what might be said in recommendation of the culture, and in detailing the advantages that might arise from extending the growth and application of this root.

I have the honour to be,

Sir,

Your most obedient humble servant,

ROBERT BURROWS.

To the Rt. Hon. Sir John Sinclair, Bart. &c. &c.

No. XXXV.

On the Cultivation of Potatoes. *By Sir* C. M. Burrell, *Bart. M. P.*

Sir,

In laying the result of the cultivation and consumption of my crop of potatoes, during two succeeding seasons, before the Board of Agriculture, I hope I may be excused, in some measure, for my inability to offer a statement more perfect in its detail, and especially as to the proportional quantity of food consumed by each animal; the experiments having, in fact, been executed under existing circumstances, with views only of agricultural advantage. Nor should I have presumed to intrude this statement on the notice of the Board, but as containing facts which may tend to corroborate the opinions and Lecture of *Mr.* Secretary Young, on *the Advantages to be derived to the Community from a more extended Cultivation of this invaluable root.* In conclusion, I beg leave to remark, that the potatoes are valued at what they actually cost growing, inclusive of rent, taxes, manure, and labour, up to the period of their being housed to secure them from frost; and the oat-straw is valued according to the price paid for part of my consumption to a neighbouring farmer during the winter of 1810.

I have the honour to be,

Sir,

Your very obedient humble Servant,

C. M. BURRELL.

To the Right Hon. Sir John Sinclair, Bart.
&c. &c.

Statement of the daily Consumption at Knepp Castle Farm, in Sussex, during the Winter of 1810, of

6 oxen, that worked when the weather permitted.
6 cows.
1 bull.
26 beasts of different ages, from two to five years old.

	£.	s.	d.
39			
26 bushels of potatoes, at 9*d.* per bushel, sliced, and given raw -	0	19	6
$19\frac{1}{2}$ trusses of oat-straw, of 36 lbs. each, at 1*s.* $1\frac{1}{4}$*d.* per truss, the greater part of which was eaten, and the rest thrown down with wheat-straw as litter - - - - -	1	1	$6\frac{1}{2}$
	£2	1	$0\frac{1}{2}$

Had this quantity of stock been kept on hay, the deficiency of my crop (which was three-fourths short of its usual quantity) must have been made good by purchases at a very serious expense, which would have amounted, at an average of 42 lbs. of hay to each beast, and at the then price, to 14 hundred and $\frac{3}{4}$ of hay, at 8*s.* per hundred, for 39 beasts, to £5. 18*s.* So that £3. 16*s.* $11\frac{1}{2}$*d.* per diem was saved by feeding them with potatoes and straw.

It may be observed that in cutting the potatoes (*which were given raw*), and feeding the stock, more attendance is necessary; but this is amply compensated by the increased value of the manure, and the improved condition of the animals, which handled much more kindly than when kept on hay.

The good effect of potatoes was very apparent on some horses in the straw-yard; for after eating them about a fortnight, their condition improved considerably; and their coats, from being very rough, became in a short time as smooth as if fed with corn. After which experiment they were given, with very beneficial effects, to some well bred colts, which improved evidently in condition; and their growth was considered to be much promoted by the succulency of the potatoes, while given in lieu of a part of their dry food.

The cows also received much benefit from potatoes at calving; the quantity and quality of their milk being much increased, by comparison with former years, when fed on good hay. And on being turned out to grass in the spring, the cows

and dry stock went on perfectly well, which is a proof of the fallacy of the contrary opinion as to cattle doing ill at grass after being fed on potatoes. And it is right to remark, that some of the beasts were fed for a short time on common turnips; but though they had double the quantity, they did not go on so well as when fed upon potatoes.

The summer of 1811 producing a very abundant crop of hay, and on an average an indifferent crop of potatoes, the principal part of the latter was applied in fatting a cow and nine oxen of different ages; the whole of which (except the cow) worked very hard till the 20th of August, when they were turned upon the after-grass in the meadows till the fifth of November, on which day they were tied up in the fatting-hovels; they were there allowed weekly one hundred bushels of potatoes (added to eight loads of hay) which were cut for them, between the 5th of November and the 12th of March, when they were sold to the butcher. The periods of their going off were as follow:

			No. of stone. stone.	lbs.	Loose fat. stone.	lbs.
1812.	Jan. 8.	The cow was slaughtered in the country	89	4	8	0
	Feb. 20.	Three oxen slaughtered in town -	145	0	19	0
			131	0	19	0
			131	0	14	4
	Feb. 27.	Two oxen ditto - - -	131	1	14	0
			129	5	13	0
	March. 5.	Two oxen, ditto - - -	125	0	11	0
			110	0	11	0
	March 12.	Two oxen, ditto - - -	130	0	14	4
			142	1	14	4

There was no precise allowance of hay, but as near as can be judged each beast consumed about sixteen pounds per diem, being very little in proportion to what they would have eaten if fed only on hay, which, at a moderate computation, would have amounted to thrice that quantity, as an ox of 140 stone would consume (it may be conceived) about fifiy pounds of hay per diem, if unaccompanied by any other food.

In addition, it is necessary to state, that one horse team has been fed partly with potatoes, thereby diminishing much of the usual consumption of oats, notwithstanding which the horses continued in very good working order.

Additional Observations.

The soil on which the crops were grown chiefly consisted of sandy loam, about six inches deep, which was clean ploughed in February; in April it was harrowed, and ploughed out for receiving the sets, on which the dung was laid in the furrows (in the proportion of twenty cart loads of twenty-seven bushels per acre). The whole was then covered in by hand-hoes, and remained till the plants were high enough not to be liable to be buried. The intervals between the rows of plants were edgetted twice with an edget made for the purpose. The plants were then earthed up with a strike-furrow plough, followed by a man with a hoe, to draw the earth close to the plants where the plough had not done it effectually, which occurred very seldom. After this they remained without further expense, except a labourer occasionally looking it over, and drawing such few weeds as sprang up.

The best and cheapest mode of taking up the crop in favourable weather, is by ploughing the land with a common plough without its coulter, and gathering the potatoes by hand, at one penny per bushel, ready for carting home.

The most productive sorts for field-culture appear to be champions and ox-nobles. But by favour of Mr. Davies Giddy, who has furnished me with some yams from Cornwall, strong hopes are entertained of a more abundant produce of food for cattle from that species of root.

With respect to potatoes being an exhausting crop, with us it is not so considered, except with reference to its abundance; for no doubt, like corn-crops, when there is a heavy burthen, the land must, in point of strength, be proportionally diminished; but in no respect is it to be considered detrimental to land which is well cultivated and in good heart. In proof of which, the wheat which followed the potatoes in 1811, afforded a good sample, and a fair average crop.

The rotation, according to this plan, would be wheat, clover, oats, potatoes, and wheat; but if a wet time should follow the removal of the potatoe-crop, and prevent the land being limed, and the rubbish picked and burnt, it would be better to prepare the land for oats, or such spring-crop as may best suit the intended culture of the soil, which must receive benefit from rest after a heavy crop, especially if care is taken to keep the land dry during the winter months, the neglect of which is the very worst of husbandry.

No. XXXVI.

On Feeding Cattle with a Proportion of Sugar. By Charles Ellis, *Esq. M. P.*

Stratford Place, May 11, 1812.

Dear Sir,

I beg to return you my best thanks for your very obliging letter, enclosing the premiums offered by the Board of Agriculture. I am not, at the present moment, in possession of a sufficient stock of materials to enable me to draw up such a memoir, as would justify me in soliciting that indulgence from the Board, of which you are so good as to hold out to me the expectation. I have been trying several experiments on the efficacy of sugar in feeding animals of various descriptions. Some of those are now in train, and of others, which are completed, all the necessary details have not yet been transmitted to me. As you express such a kind interest upon the subject, I venture to request that you will be so good as to suggest to me the particular questions to which you think that the Board would be desirous of obtaining an answer. But in the mean time, I take the liberty of stating such general results as I can supply from my recollection. I have fattened about a dozen pigs, four cows, and two calves. With respect to pigs, I have ascertained, that three pounds and a half of sugar are rather more than equal to a peck of barley-meal (or about 10 lbs.); that is to say, that a pig would fatten quicker upon a mixture of barley-meal and sugar in these proportions, than on double the quantity of barley-meal. The last pig which I fattened was weighed at the time when it was put up, and when it was killed, and was found to have gained at the rate of about 2¼ lbs. per day. The sugar which I employed was simply dissolved, and mixed with the meal: I have been informed that when given in a state of fermentation, it is still more efficacious. With respect to calves, I have fattened only two; they were fed solely on new milk and sugar, of which latter they consumed rather less than half a pound a day. One of them was sold, at five weeks old, for £4. 10*s*, the other for £5.: I do not recollect at what age. These two experiments were remarkably successful. Having varied the experiment with some others, and attempted to substitute skim-milk for new milk, I found that

change of food to disagree with them, and that they lost instead of gaining flesh. I have now another in the act of fattening entirely upon new milk and sugar, and it is very promising. Of the four cows which I have fattened, two were so far advanced with calf, that I was forced to sell them to the butcher before they were completely finished, though they were very good meat. I have not the details of their weight, but I believe that the result of the experiment was, upon the whole, not less satisfactory than that of the experiment on the two which were exhibited at Lord Somerville's show, one of which obtained the premium. Of the details respecting these, I enclose a statement, which was published by Lord Somerville.* I

* At Lord Somerville's spring show, the premium for the best fat beast of any description, except such yokes or pairs of oxen as were qualified for their particular prize, was adjudged to one of two Devon cows, exhibited by Charles Ellis, Esq. of Claremount, in preference to six or seven others. These cows were selected from a lot of twenty-four, were weighed at Lord Somerville's Spring show 1811, in the lowest possible store order, and were afterwards summer-grazed by Lord Somerville on his marsh-land, where they made good progress. They were purchased by Mr. Ellis, and put up in the stalls at the end of October, where they remained seventeen weeks and two days. During that time they were fed on hay, turnips, and contaminated sugar in lieu of oil-cake. They consumed (at the rate of rather less than 2¼ lbs. each per day) 5 cwt. and 23 lbs. of sugar, which at the present price, exclusive of duty, would cost 11*l.* The same quantity at the average price of last summer, i. e. 33*s.* exclusive of duty, would have cost 8*l.* 13*s.*

These cows would undoubtedly have consumed at least four oil-cakes per day, perhaps from five to six each: four cakes per day would, in the same period, have amounted to 968, which at seventeen guineas per thousand, would have cost more than 17*l.* As nearly as can be ascertained, the whole quantity of hay and turnips consumed was not greater than what must have been required in feeding with oil-cake, with the difference, perhaps, that more turnips would have been consumed if oil-cake, which is of a dry heating nature, had been employed; whilst, on the other hand, the sugar being given in a diluted state, may induce a greater consumption of hay.

The live weights were

Spring Show 1811.	cwt.	qrs.	lbs.	*Spring Show* 1812. cwt.	qrs.	lbs.
Of the old cow - - -	7	0	0	12	0	0
Increase in twelve months -	5	0	0			
Of the younger - -	7	0	14	11	3	0
Increase in twelve months -	4	2	15			

The dead weights were,

Of the old cow 99 stone; loose fat 15 stone 6 lb.

Of the younger 100 ditto; loose fat 16 stone 2 lb.

The kidneys of both were unusually good.

have at present ten oxen, which will be fit for the butcher in about a fortnight. These oxen were fed in the same manner as the two cows which were exhibited, while my turnips lasted; but latterly they have had only syrup and chaff with their hay. They have improved less rapidly since they have been deprived of the turnips; and I apprehend it is not possible to increase the quantity of sugar so far as to compensate for the want of some substantial food in addition to hay. I have not fattened any sheep this winter; but I have given sugar, diluted and mixed with chaff, to my ewes in lambing time, and I have found that it answered extremely well, particularly with the old merinos; and I conceive that sugar might

The old cow did not set so firm, when cold, as the younger one, which was, in some degree, owing to her age, but perhaps, in part, to the sugar, which possibly may not always harden or set like oil cake; an objection, undoubtedly, to such animals as have to encounter a long drift, but not to those within a reasonable distance of their market.

Many of the first butchers and salesmen in London, who saw these cows at the show in 1811, expressed their doubts of the possibility of making them fat by any means: and few, if any, expected that upon a frame so small, and so poor, as much meat could be put by at least 20 stone as these cows were found to carry at the time when they were killed.

It is to be regretted that the opportunity was missed of weighing them on their return from the marsh, as it is impossible to state how much progress they made in the stalls. But the facts above stated appear, at least, to warrant a presumption, that sugar, free of duty, may be employed by graziers with considerable advantage.

We are, however, authorized by Lord Somerville to state, that had they been sold in Smithfield on the 25th of October, the price asked, and their value, would have been 24*l.* each: the increased value in the same market, when sold, was 9*l.* sterling on each cow, which was a return (besides the manure) of about 10*s.* per week each: what proportion of the profit belonged to the hay, what to the turnips, and what to the sugar, is not possible to obtain with any view to profitable grazing, because it would be folly to stall-feed any animal on oil cake, or on sugar, without other produce.

The Government have, at the request of the West India planters, allowed a limited quantity of sugar to be delivered, free of duty, for agricultural experiments; annexing, for the security of the revenue, the condition of its being previously contaminated by the mixture of small quantities of quassia and asafœtida, by which process it is rendered inapplicable to any of the ordinary modes of consumption, while it remains uninjured as food for cattle. Sugar thus contaminated has been employed in fattening not only the abovementioned cows, but other cattle of the same description, as well as calves and pigs: it has also been given with advantage to sheep or horses. When given to bullocks, sheep, or horses, it is recommended that it should be mixed with chaff; when given to pigs, with meal. In all cases it should be diluted to a thin syrup. To calves it may be

be employed with great advantage in feeding sheep during the interval, which is often very distressing, when the turnips are exhausted, and grass not yet abundant. I have given sugar also to my horses; that is, to a yearling colt, and to my saddle-horses, when at grass, instead of oats, and when in the stable mixed with them; and I have found that about 2 lbs. of sugar are equal to three quarterns of oats. In this case, also, I have given the sugar diluted and mixed with chaff. All the sugar which I have used had been contaminated with a mixture of asafœtida and quassia, and was, in consequence, allowed to me free of duty, and cost about 40*s.* per cwt. The meat was excellent, and not in the slightest degree tainted by this mixture; and I have been assured that, where it has been tried with milch-cows to the amount of a pound of sugar per day, it has not at all affected the flavour of the milk, cream, or butter. The flesh of the calves was remarkable for its whiteness.

I remain,

DEAR SIR,

Your faithful humble servant,

CHARLES ELLIS.

To the Right Hon. Sir John Sinclair, Bart.

given with milk. The asafœtida does not, in the slightest degree, affect the flavour of the meat, not even of pork, which is known to be altogether spoilt by oil-cake.

Should the use of sugar be found in some case not so adviseable as that of oil-cake, yet by extending the means of carrying on the process of feeding, it is to be regarded as an useful auxiliary to the farmer, not only as it appears to supply the place of oil-cake at a considerably less expense, and thereby may tend to reduce that article to such a price as shall render its application profitable, which it certainly has not been since it exceeded ten guineas per thousand; but also as it will afford an increased quantity of manure, an object of the first consequence to the community.

Gentlemen desirous of employing contaminated sugar for agricultural purposes, may obtain a supply of it, free of duty, by application to Messrs. Deffell and Co. Billiter-square.

No. XXXVII.

On the comparative Merits of Horses and Oxen, in the Business of a Farm. By Mr. George Whitworth, *of Cuxwold, near Castor, Lincolnshire.*

OBSERVING the Board of Agriculture desires to be informed of the comparative value of horses and oxen in the general business of a farm, I venture to give the result of my experience, and shall endeavour to make a fair comparison on this occasion; and if I offer any thing that will be at all acceptable to so highly respectable an Institution in the course of this essay, I shall be happy to be honoured by its publication for the benefit of my country.

I have been long in the habit of using both horses and oxen on a pretty large scale; and I am confident that, at this moment, both myself and all the farmers in this district, employ too many of the former, and use the latter in too confined a manner. In this part of the kingdom the ox is rarely used in the plough: in the opinion of some of the most respectable agriculturists of the country, he is too slow to be profitably adapted to that part of husbandry; and I have often incurred much ridicule, and many severe sarcasms from my neighbours, on making the attempt to plough with them in the manner of horses; but I am rewarded by my success; and I hope, before long, to perform a considerable part of the business of the farm with them.

The oxen I plough with are of a mixed breed, between the Durham and Lancashire sorts; they are large, and tolerably active; their harness is chiefly of wood,—the cost of it is about 15*s.* per ox. I use two to one plough (the common swing plough); they go abreast—are guided by lines, and are as docile as horses. They work with my horses every day, and I dare say would be happy to be fed with them; but this they are denied; for though they contribute so much to producing the corn, they rarely taste it; however, at the close of the last turnip-season, I was obliged to press the oxen very hard, and I then gave each of them half a peck of split barley, which seemed to benefit them considerably; and had it not been for their aid, I should not have been able to have sown my turnips in season, the horses being unable to work half the proper time, from a distemper

which much resembled the strangles, and which the same horses have experienced, or something very like it, repeatedly. I was anxious to shew how far I had brought my cattle to be useful, and accordingly I sent two pairs of them to a neighbouring ploughing meeting, but not with the hope of obtaining a prize; for it never struck any one, who had the direction of the business, that the ox could be made to go a sufficient pace to be placed in competition with horses; and I understand the surprize of the meeting was very considerable, at both my ploughmen finishing their lands, before several very good horse teams had ploughed the same quantity. Of this I enclose a certificate, sealed up as the Board directs, and will furnish any other particular which may appear to require a voucher.

The horses I used for the plough, before I began with oxen, upon strong work, were short sized ones of the black cart breed; conceiving this description to possess sufficient strength, and more hardihood than larger animals, and certainly more capable of quick motion; and I am of opinion requiring less food generally. I am rather confirmed in all this, from having occasionally worked heavier and larger horses, and finding them seldom do well with me: they may be very superior for the dray or waggon, where amazing weight and great exertion must be occasionally combined; but a farmer has seldom a load of such a description, but part of it may be left 'till another day, which is much better than distressing his team; and where a load so extremely large occurs that there is a chance to injure the cattle, I should prefer oxen. Two of them I think are allowed for one horse in all the highway acts, and pay no more generally at the toll-bars: they pay no tax; and I hope to see the day when there may be further encouragement to use them.

From what I have advanced, it will almost be considered matter of surprize, that I continue any horses upon my farm; but though I think my oxen vastly superior to my horses, taking the expense of keep and the labour into the account (the latter of which, in a general way, is equal, whilst the former is always in favour of the ox), there are departments where I give a decided preference to the horse; for instance, the light harrow, and even the plough, on my lighter soil for turnips: at the last ploughing I would draw by a half, or even a full blood-horse; some of these I use to advantage at that time; and the ox works the heavy harrow, or is employed at the dung-cart: indeed in all light work, where extremely quick motion is possible and desirable, I find the blood-horse a better animal than my ox, and the blood-horse only. Against any of the cart breed I would not scruple

to match the ox at any work that can be named; and I rather think an individual ox might be matched against any horse whatever for a period of twelve months; from the former being subject to so few diseases, and the latter to so many, I should calculate upon the ox being the winner.

The ox is objected to by many farmers, because they consider their pastures are not sufficiently good for their support in summer; but this I regard as very unwarrantable; for I believe fully from my own experience, that an ox may be kept in any situation where a horse will thrive; and when at large, I find the latter more inclined to break his pasture than the former. Indeed I do not know so great a plague upon a farm, as the horse when he is not constantly employed; he is always in danger, and you seem to be keeping him without an object. On the other hand, the ox is generally quiet, and satisfied with the rest allowed him; he grows and improves considerably, and pays amply for his keeping, by the addition that is made to his size and weight. Many contend that the farmer may, by working young horses of the cart-breed, make a considerable profit; but I do not generally find it so, but on the contrary; for at four years old (before which time this animal is not of much vatue for work) he is almost at the height of his worth in the market, and in a few years he rapidly declines; and in the estimation of the dealer, at nine or ten he will sink perhaps a third from the price he first cost. From four to eleven I consider the horse to afford the most profit to the farmer; but it is from his labour, which for the last six years of that period will be so valuable, as to counterbalance the declension in his price. In some situations a three years old horse may be used, but generally they are not of much value at that age, and after eleven or twelve they decline so much in most instances as to be unprofitable to the farmer; they are slow after that period, usually require more support, are subject to diseases in their legs, often deaf, affected in their wind; and the mares that have been well kept and hard drawn, and that have not bred before, will often prove barren. Some keep mares in preference to colts, occasionally breeding from them being a leading inducement; but I do not consider them of more value on that account, because the farmer, who has a number of his mares with foal, must be under the necessity of filling their places with other horses at a season when every one will most want; of course he must give a high price if he purchases, or, which will be the same thing, hold horses of his own at a great value, which he would not otherwise have kept. Where mares

are worked fairly only, and kept up, which is usually the case at the time of putting them to the horse, they will prove barren perhaps twice in three times. I think I have found it so; and those that breed require more attention than is usually given to them, amongst a number of working horses; therefore it may not be, on account of the uncertainty and hazard, very advisable to put mares, that are constantly employed, to the horse. One advantage in using mares may be the breeding from them in case of accident, or when they decline in value; and if they are good ones, and of a respectable stock, it is a very great one; and another recommendation to many is their not costing so much in the first instance as colts; and of course where lameness occurs, or total loss, it will be easier born. But the ox must here be of much more importance than the horse, for I find, by experience, that an injury that totally ruins the latter, does not, in many instances, much affect the value of the former.

I break in my oxen when about three years and a half old; and I consider I work them profitably about four years, when I turn them away, which is usually when the turnips are sown; they are generally in such condition that they make tolerably good beef by Christmas, without resorting to corn or oil cake. In the turnip-sowing-season, a farmer requires all the force he can muster, and at this period he breaks in the young oxen to great advantage; with gentle usage they are tolerably manageable in four or five days; and I earnestly recommend it to every one who has any concern with them, to treat them with humanity, gentleness, and kindness, and the driver will be amply repaid by the docility and willingness of his cattle. The ox may not be endowed with so high a capacity as the horse, but he is an animal of no mean instinctive powers, and seems to be the most patient and obedient of all our domestic animals: he will apply his neck to the yoke as often as the driver will direct, and exert all his power, even where the object is so fixed as to be made no impression upon, and he will not refuse this in the deepest and most miry road. In leading of timber in woods this frequently occurs; and here the ox is very superior. The horse will in this situation be of little worth compared with the ox. The finest horse-team, with the most skilful driver, after the carriage once sticks, will seldom extricate it; after two or three efforts these animals begin to look behind them, and the waggoner may cherish, or use severity without any avail: indeed, I have seen such a disposition made, that the fair exertion of two horses would have taken the carriage out, when four or

five that have once experienced its sticking, will pull in so disjointed and ineffective a manner, as to be only calculated to break the harness, and tire the patience of all concerned with them. Every one who has had to do with horses, will occasionally have observed this; and in deep clay and heavy roads, those who have witnessed the steady and even exertion of the ox, must prefer him greatly to the horse, which will here, whilst his wind remains, be scarcely governable, and when that is gone, he either tumbles down, or the carriage sticks fast. Some who are willing to allow the ox some merit, ask what he will be in hot weather, when the gad fly, as it is commonly called, is troublesome? I answer, this insect, or some one much resembling it, is equally tormenting to the horses, as every traveller must have experienced. The ox tribe, it is true, when at large in the pasture, will erect their tails and run in herds when this fly approaches them, and, on account of the shade the hedges afford, they naturally make directly for them, and occasionally break their pasture; and from this it is inferred they will be liable to start when in harness; but I can positively affirm this never occurred with my cattle; and as to heat, I find them able to bear it as well as horses, at least. I should expect the ox that is kept below his work, will sink in a moderately warm day; but if he is stout and fairly kept (and surely humanity ought to forbid our attempting to use an animal that is too low, to perform a fair day's labour without distressing him,) we do not doubt his performing vastly well. As a proof of the ability of the ox to work in hot weather, I can assert, that mine were employed at the dung cart on the thirteenth of July 1808 (the hottest day probably known in this island), and they were not in the least oppressed by it.

As to the quantity of food the horse or the ox will consume, it can I consider be of no importance to state any instance of it, as it will continually vary in different animals, and all I think right to observe on this head is, that the most compact made animals of both sorts will in general require least support; but I have known some of this description enormous eaters. An ox is certainly kept at an easier rate than a horse; in the summer he is of value amongst the sheep, making the pasture better for them; whilst the horse is, by eating so near the ground, and feeding only where the sheep will graze, particularly injurious.* In the winter months a coarser sort of

Note. * The horse feeds perpendicularly downwards with his fore-teeth, as does the sheep; whereas the ox feeds by his tongue, at the side of the mouth, by which means he can only take the coarser grasses refused by the sheep.

food will do vastly well for the ox team; hay and good oat-straw, mixed half and half, cut into chaff, is all that is necessary when the work is not severe, and this is all I allow mine in common; but when I am under the necessity of pressing them severely, I gave about a peck of corn to each pair, generally barley ground or split. I should allow a peck of oats to the horse that I expected the same work from; and I think it but fair so to treat that animal, that whilst he is labouring for us, he may be comfortable, which all consider of so much importance when he is dead. I do not know why many who use oxen, should refuse them corn at all times;* they surely are as deserving of it as horses, and will, I am certain from my own practice, pay for it in general much better. A peck of good oats with good chaff, such as I before spoke of, never makes a horse fat that does a fair day's work; and when we see a horse-team in very sleek and fine condition, abounding in flesh, we may fairly conclude they are either overfed or under-worked, or perhaps both. If it can be done, I should advise that the oxen are favoured as much as possible the last few weeks of their working; they will of course be much fresher and feed better. When oxen are turned away to fatten footbeaten and worked down to mere skeletons,† we must not expect them to lay on much beef during the whole summer; this abuse has, I consider, done more injury to the cause of oxen as beasts of draught, than every thing else combined. Many of the graziers I know in this district object to old oxen, because they lie long upon the ground, as they term it; and well they may, when so many of them are only just able to rise from it, when they are turned away to fatten. With those who work oxen in this district there is scarcely any system: sometimes a farmer will use a few pairs for taking out the manure, and harrowing the rough land after the second ploughing for turnips, and then for some years again he is without an ox upon his farm; of course the labourers are in general prejudiced against them, not considering if they were brought into general use, they, as well as the whole of the working people of this island, might oftener sing "the roast beef of old

* *Note.* Instead of allowing corn, substitute turnips; an additional motive for which is, that cool the animal, heated in some degree by labour, whilst the saccharine property of the turnip nourishes at the same time.

† *Note.* To turn oxen to graze in very low condition must at all times be avoided; for they not only take much of the best part of the season to come round, but they are too apt to be scoured, as every poor animal is, by strong herbage. Many oxen, and thousands of sheep, are thus destroyed.

England," with a comfortable piece upon their table for themselves and families. The quantity of corn saved would be very considerable; for the ox, except he is worked very hard, will not require any; mucilaginous food agreeing with him generally better than farinaceous. From the circumstance of his being a ruminating animal, he will not ask that constant feeding and attention which the horse necessarily demands: he will fill his stomach in a short space of time, and afterwards lie down and take his rest: he will thus, the moment he has been fed, leave the ploughman at liberty to follow any other business upon the farm, whilst those attached to horse-teams can do little else but wait upon them.

I never shoe my oxen, and they never seem to require it; but I believe some may, their feet being more tender. I am told this is the case with the highest bred Durham cattle; but whether this sort is so useful for the yoke, as many other breeds of the island, is with me a question. I cannot speak exactly from my own experience, but from what I have observed, the Sussex and Devon breeds are the most desirable as beasts of draught. I am about to try the Sussex; and when I have experienced sufficient to warrant my speaking of their merits, I shall be very ready to communicate any fact that may be of sufficient importance to be published. Having, I trust, been as particular as the subject demands, I conclude by observing, that it will be a great pleasure to me to find, by the notice of the Board, that I have fully understood their intention.

CERTIFICATE.

We the undersigned beg to declare, the two ox-teams belonging to Mr. Whitworth, of Cuxwold, in the county of Lincoln, ploughed half an acre of land each at Horganby, in a superiour manner, on Thursday the 5th of March, 1812, in less time than several very good horse teams which started for the premiums; and that we were so satisfied with their performance, and lamenting there was no prize offered for ox-teams, begged, on behalf of the Society, to present the men ploughing with them with a guinea each, which was unanimously agreed to.

JOHN KIRKBY,
J. W. SWAN.

April 20, 1812.

The Board being desirous of receiving some additional Information from Mr. Whitworth, *in regard, 1st, To the Breed he termed "Lancashire;" 2d, In regard to the Harness; and, 3d, In regard to the annual Expense of feeding a Horse and an Ox respectively—applied to him for these Particulars, and received the following Letter:*

Cuxwold, near Horncastle, June 6, 1812.

Sir,

In reply to the communication I had the honour to receive from you, I beg to observe, I feel highly honoured by the notice of so very respectable an Institution as the Board of Agriculture. I shall attend to the questions now furnished with great pleasure; and if at any time you consider me capable of rendering any service, I shall be glad to be favoured with your commands.

In answer to the first question, I beg to state, you understood me as I intended. Something more than forty years ago, the Lancashire bull, an animal which pretty much resembled those since called the Rollwright breed in Warwickshire, was first introduced here to cross the old Lincoln cattle, which, from what I have seen of them, were of nearly the same character with the Holderness short-horned sort of the present day. The first cross succeeded in almost every instance; but many, by continuing the long-horned bull, to which they at first attributed all the improvement, thought afterwards considerable injury had been done by going too far; and the generality resorted to the counties of York or Durham for short-horned bulls to restore the size they had lost, and to bring them back to something like the old breed of this county. For several years the short-horned sort then prevailed, and the opposite kind was supported by very few advocates, till the sale of the Rollwright stock, when the famous bull, Shakspeare, was purchased by some respectable breeders of this neighbourhood, and many were induced to cross with an animal of so far famed a race. The result was here so favourable, as to make it a leading question of the time, which of the two breeds was superiour. Some, having before them the former failure, tried this second crossing with caution; whilst others, confident that the excellence was with the long-horned bull, used him

freely; and these were generally unfortunate: the cattle from the second and third crosses being evidently not sufficiently hardy, and falling far short of the size of either of the parent breeds in many instances. The cattle of this county are now generally of a mixed sort; and, according as the individual is happy or otherwise in the choice of the bull, his stock will improve or deteriorate. We have lately had several Hereford bulls brought into Lincolnshire, and they seem so far to have done well for us; I have also seen some of the Devon breed in different parts of the county, and the first cross here is certainly a very desirable animal. Some breeders are contending for the Kyloe sort, whilst a few prefer the polled cattle of Suffolk. I, as before stated, am breeding from the Sussex, conceiving this sort to be as valuable, as a working animal, as any other, and, at the same time, combining every requisite to render it very desirable. There is also a strain of Dun, said to be originally from France, which is widely extended, and are very good cattle. There have been very few stocks of the pure long-horned in this county at any time, and I now know of none in this district. Upon the whole it may be said, we are without a positive character, or a pure breed of any description, in this great county; yet many very valuable stocks of cattle will be found, in every part of it, of all the various mixtures and combinations that any thing like judgment can be conceived to have had a hand in directing. Perhaps I have been more full than required of me on this head; but I supposed a general description of the cattle of Lincolnshire might be acceptable to you and the Board; and under this impression, I offer it with the greatest deference.

With respect to the harness, I have made what I consider an improvement; and, instead of the ox-team or chain which links them to the plough, I have substituted a pole of good tough ash, $7\frac{1}{2}$ feet in length, and about $2\frac{1}{2}$ inches in diameter, with an iron cap at each end with an eye, to which half a dozen links with one swivel are attached, to lengthen it, according to the size of the ox. I draw all in pairs, in the common yoke and bow; and they are guided by lines fixed to a small halter of common girth-web. The advantage of the pole is, in the first cost being less; it is not liable to chafe or gall the cattle; and they cannot possibly get their legs over it at the turnings, a thing which sometimes occurs with the chain, and causes considerable trouble where the oxen are not particularly steady.

With regard to the annual expenses of keeping the horse and the ox, it must be considerably in favour of the latter. In the summer the ox will work, if he is allowed a good pasture, for nine or ten hours every day *without corn;* but the horse must have an allowance of three-quarters of a peck at least, to enable him to bear the same labour; and if he is kept at large, from his eating so much closer, he will destroy more grass at the same time. I believe every horse I have kept has annually consumed about seven quarters of good oats, whilst I never gave an ox a third of that quantity. I should consider the expenses of keeping generally as under, valuing the oats at 24*s.* per quarter, and taking the weight at 37 lbs. per bushel.

Horse, Dr.	£.	s.	d
To 7 qrs. of oats - -	8	8	0
To hay or clover, 2 loads charged low - -	4	0	0
To straw - -	0	0	0
Shoeing - -	1	0	0
Attendance and chaff-cutting - -	5	0	0
Grass 21 weeks, at 2*s.* 6*d.* per week -	2	12	6
Total expense	£21	0	6

Ox, Dr.	£.	s.	d.
To 2 qrs. barley, at 30*s.*	3	0	0
To hay or clover, 2 loads charged low -	4	0	0
To straw - -	0	0	0
Shoeing, if necessary	0	7	0
Attendance and chaff-cutting - -	3	10	0
Grass 21 weeks, at 2*s.* per week - -	2	2	0
	12	19	0
Cr. by increase in value	4	0	0
Total expense	£8	19	0

I have not considered any declension in the value of the horse, because if they are bought at an early age, and sold again before they are extremely old, they will make near prime cost; and I thought it might not be correct to do so, because some farmers insist they can do their work by young horses, and profit much by selling them to the London draymen and waggonners. I only say they are more fortunate than I have been, for so far from being a profitable, they have generally been a losing concern; and I always have found, when I used young horses, they were more liable to diseases than oxen, and not capable of enduring that hard labour which the backwardness of a season, or the crouding of business, will often

require. I have not allowed for straw, because this is consumed on every farm here by covenant, and is as well converted into manure by one animal as the other; and on diseases and farriery I have made no charge on either side: the labour I consider nearly equal. It will add to my happiness if this meets your concurrence and the ideas of the Board.

I have the honour to be,

SIR,

Your obedient Servant,

GEORGE WHITWORTH.

To the Right Hon. Sir John Sinclair, Bart.
&c. &c. &c.

No. XXXVIII.

In Claim of Premium No. XXXIV.

On the Culture of Wheat, so as to prevent the necessity of Importation. By the Rev. James Willis, *President of the Christ-church Agricultural Society.*

——— Gens rigidas mutat leges, ac omnia vincit.

To the Rt. Hon. Sir John Sinclair, Bart. President of the Board of Agriculture.

INTRODUCTION.

When a nation, insulated like England, is compelled to expend annually from five to seven millions of bullion solely in the importation of foreign grain, a reflecting Englishman is induced to suppose there is something radically wrong in our agricultural system, that necessitates a people to export so large a sum of money in the import of an article which, with due and proper attention, they could procure themelves.

This vast sum taken for *grain* only, by an importing people from us, and at *present* in solid cash, is a dreadful evil;—when we consider, too, that if this immense sum was fairly and firmly directed to its proper object, the cultivation of our *wastes*,—an annual and adequate supply of all grain, so as to cut off all necessity and expediency of import, would be raised at home for the wants of the people. The nature of our soil or climate cannot be considered, *generally*, as adverse, or unfavourable to every species of agriculture. What we have hitherto done in this laudable pursuit proves the reverse; we only want the true and genuine spirit of husbandry to cultivate the land that Providence has given us, to do away, and resolutely dissipate, some of our antient and deeply rooted prejudices;—then the immense sum of money we absurdly enrich our enemies with, would be expended in growing, on our own soil, those very articles for which we

are *now* dependent on the exertions, humour, and caprice of the continent. It is not difficult to point out the means of enabling this kingdom to supply itself with bread-corn without a foreign importation; the grand difficulty is in removing those obstacles and impediments, that prevent our using the means that nature has afforded us. Nature has been bountiful and extremely kind to us, in giving us a country fruitful and productive; and amply rewarding us, as far as a fair and proper cultivation has extended. Thus far she has been most liberal, and always will answer our most sanguine expectations; but it is the selfish avarice of man, coupled with his inveterate prejudices, that check her kindness, shorten her produce, and ultimately occasion the innumerable difficulties that we now, at this moment, labour under.

It must then be allowed, on due reflection, that the " land we live in," will kindly support us, without foreign aid or assistance, in all the requisites absolutely necessary for the comforts of man, if man would be only attentive, industrious, and liberal, as she is kind and liberal to us.

The consideration of the state of Europe, that a great portion of our daily food may be witheld, or not, according to the will of the Ruler of the continent, together with failure of any of our crops, should rouse us surely to inquire into these things at least; when famine stares us in the face, it may be then too late to remove those checks, and to adopt those means, in agriculture, which sooner or later, under existing circumstances, must be introduced.

The obstacles to be removed, and the surest means of removing them, for the general good, as well as providing an ample supply of grain for the use of the kingdom, must now be considered: but in the consideration of the several points in this essay, I am to hope I shall not offend the feelings of any. The times, the subject, require the sincere and undisguised sentiments of every man. It is the duty of an Englishman to state frankly and fairly, in the day of peril, his opinions, which may benefit his country: under this idea I shall state *mine*.

The most prominent obstacle to the increase of grain, is *Tithes;* the most prominent encouragement to the growth of grain, are *Capital, Enclosure Bills*, and *Leases*. I shall beg leave to consider the first subject fairly and distinctly, with its evil tendency; then the three succeeding, with all their beneficial results.

CHAPTER I.

On Tithes.

ON *Tithe*, much has been said without producing any great and national good; much more *must* be said, and much general evil must be sustained, before we think rightly on this subject. To think *rightly* on these ecclesiastical dues, is to weigh well, in these times of need, the prejudices that maintain them in their antient form; the prejudices that will listen to no exchange, no commutation. Where the pressure on the nation is extreme, surely some adequate compensation and equivalent might be found to satisfy the wishes of the tithe-holder.

The liberal ideas of the present day in the laity, as well as clergy, might induce us all to see these impediments to the national agriculture in a proper point of view; to relax a little in the rigid demand of an antient right, when a just equivalent might be given; and cordially co-operate with the people, when an essential interest is at stake. It would be needless to enlarge on the perpetual feuds, the endless strife, that divide the tithe-holder and the people; separating them from the establishment, and creating a new political and religious power, which may eventually shake the foundations of the kingdom. Many expedients and suggestions have been recommended, hitherto in vain, by men of ability and talent. The clergy, however (which few understand), have not the deep interest in tithes as the laity of the country; and some have imagined, that if the clergy *alone* had been concerned in this revenue, some change would long ago have been made to relieve the farming world from the pressure of its yoke, and a full, free, and open latitude given to the fairest exertions of agriculture.

In hopes of a rational exchange, in the lieu of tithes, we must go farther than the clergy; the lay-impropriator must be considered, who has by far the greatest portion of this ecclesiastical provision for the *church*. I rather think, from what myself and others have known and paid to this class of tithe-holders, that the public, in any arrangement about their tithes, would have much more difficulty in satisfying the demands of these gentlemen, than the public ever had, or will have, with the clergy.

Look at the present revenues of the church, compare the compositions paid to

the clergy with those paid to the lay-impropriector, and by the comparison, throughout the kingdom, consider who bears hardest—the former, or the latter. The former usually has, but unfairly so, the lesser estate, and the greatest obloquy and reproach; while the latter run away with greater profit, without any labour in the vineyard, with the lesser abuse.

Truth and experience call on me, in justice to the clergy, to make these observations, which flow not from a partial pen; but as I now confess myself one of the order, I shall the more cheerfully assign to them that "honour, to whom the honour is due." I cannot resist giving one proof of my statement. A certain Chapter of a cathedral, to redeem their land-tax, sold the great tithes of a certain parish to a certain lord. While the tithes were in the hands of the church, they yielded about *eighteen* hundred per annum; but when the same tithes became a layman's, their yearly produce instantly arose to near four thousand per annum. This is a fact well known in my neighbourhood, and most fully supports my assertion.

After this manly defence of my brethren, and which they most truly merit beyond the powers I possess, it will be necessary to point out some proposition or remedial plan to meet and alleviate the existing evil. The state of agriculture and of the world, the exigencies of this nation, imperiously demand some beneficial commutation, founded on mutual arrangement and convenience, equal to the thing taken. Those good people who talk of an abolition of tithe, talk most absurdly, and merit no reply; but this is no reason why some attempt should not be made to moderate its weight, and give a new turn and life to agriculture. The arts of life advance but gradually; every thing is progressive, and nothing is brought to perfection at once, to which by knowledge and wisdom it may afterwards attain: under this idea, a change of some sort may be *first* tried in all shapes and forms; and after a fair trial of the *best*, if approved, then to be universally adopted throughout the kingdom. Surely it would be a glorious measure, where none would be materially injured, to add to the happiness of the many. To meet the business fairly, divested of all prejudice, seems to be the great end or desideratum in which we are all, clergy as well as laity, most deeply interested.

In the struggle between two different interests, we should bear in mind the *national* good; that is highly concerned in the welfare of the intended measure.

Each party should mutually accede; without this compliance, no hopes can be entertained of bringing any measure to a desirable conclusion.

After what has been said, some plan may be expected from me; indeed, I think it my duty to give it, with all due deference, to the public opinion, however *inefficient* it may be considered as to the object in view. It may possibly excite our hopes and desires, at least of suggesting something that might be farther improved, by much abler hands, for the good of the community.

Suppose the annual value of a living, at *this* period, to be £500. per annum: to meet the fluctuating price of grain, let the average of the gazette prices, for every *half year*, determine the quantum to be paid in lieu of tithes. The two church-wardens should then be empowered, by an act of parliament, to levy, by a half-yearly rate, the supposed £250. on all occupiers of land within their parish, but always regulating the *tithe*-rate on the average of the gazetted prices. The church-wardens, of course, must be armed with similar powers as the collectors of the property or land-tax, to controul the obstinate and perverse; and themselves also to be subject to certain penalties, in default of not paying the tithe-holder twenty days after Michaelmas and Lady-day, annually, a moiety of the tithe so regulated as above mentioned. Vestries may be called, as on all other occasions, to aid the church-wardens in adjusting the tithe-rate; and in case of dispute, the petty or quarter-sessions, as in the appeal of the poor-rate, shall have full authority to hear and determine. A responsibility must be attached to some one to levy the rate, and pay the tithe-holder his rent within a fixed period; and none so proper as the church-wardens, who are more immediately connected with the affairs of their respective churches. These parochial officers would most readily levy and collect the *tithe* at the same time as the church-rate; and if any extra trouble should arise in adjusting the tithe-rate, if they are wise, they must consider themselves amply compensated for their pains, by being instrumental in removing from themselves and neighbours, what is usually thought a sad oppression to the agricultural interests of the kingdom.

As to the estate of the tithe-holder, how is it in the least injured by this plain and simple proceeding? The rise or the fall of the value of tithe is provided by the rise or fall of grain. The income of the tithe-holder is brought to him without trouble. The unpleasantry the clergy usually feel in making a proper bargain

with their parishioners, and the still more unpleasant and harassing expedient to *both* parties, of taking tithes in *kind*, would be completely obviated. These are not the only happy results of such procedure; but let us take into the account, the harmony and peace throughout every parish in the kingdom; an animated and unrestricted cultivation of the earth; an extended enclosure of our wastes; the establishment of the church and state esteemed; and, finally, an inexhaustible fund of bread-corn, potatoes, and other grain, would be instantly, as it were, raised to feed the people, so as completely to cut off all necessity of depending on other nations for our support.

If these happy results, at this awful *crisis more particularly*, fail to claim our most serious attention, we must, with an increasing population, still be dependant on our enemies even for our necessary supplies, which *our* own lands should produce. If these great and national blessings are to be denied the people by the bigotry of some, and narrow-minded prejudices of others—if every unfeeling and unreasonable man is to prefer his *own* private interest to the public safety—it is high time, if all the "*amor patriæ*" has basely left us, that we should be chastised most severely for our obstinacy and perverseness. Most probably the time is not far distant, when necessity will compel us to see all these things in a proper point of view. The necessities of the *present* year, I think, will bring us to our senses. Agricultural boards may recommend measures in vain; essays may be made and wrote without any possible effect: nothing will bring about these salutary measures, or make any useful impressions on the minds and feelings of those who ought to have felt these impressions before, but absolute want and starvation in all her dreadful forms.

But to return to the plan respecting *tithes*. The simplicity of the plan, I hope, can be no objection to its adoption; and as I would not recommend any scheme which I would not use *myself*, I must then inform the Honourable Board, that the tithes of my parish are *now*, and have been for some years, paid me in the exact manner I have described. I am perfectly satisfied with this mode of payment, which gives me not the least trouble or care; and I believe, and at least I *hope*, that my parishioners have the same comfortable feelings. While tithes exist, the best way for *both* parties is to make the burden as palatable as the nature of the thing will allow; with the untoward it too easily becomes an instrument of horrid oppression. Under all circumstances, I do sincerely advise, not only my

brethren, but all tithe-holders, to be content with a fair and honourable compensation: nothing is obtained in the end by avariciously grinding and screwing up the tithes, beyond their just and reasonable value, but wrath, and bitterness, and malice. As these things hurt the peace of the individual, without any adequate return, in my humble opinion, or any possible profit equal to the vexation, so they operate on the great agricultural interest of the nation, becoming an insuperable bar to farther improvement. Much *theory* has been thrown away on the subject of tithes; but I have presumed to point out an easy, simple, and *practical* mode of comfortably arranging their adjustment, verified in myself. If I had *ten* livings, instead of *one*, I should be perfectly happy in having my payments made on the same principles. On the whole, I verily believe a clergyman loses nothing by leaving the value, as well as the whole arrangement of the collection, and levy of his tithe, to the management of his *vestry*, which I have always found to be liberal, even generous in the extreme, in gradually raising my tithes, according to the rise of grain. Let the clergy leave these things to the *honour* of their parishioners, more than many are inclined to do, and I will venture to say, that *nine* times out of *ten*, they will be more *honourably* and liberally rewarded for their confidence, than any interference or positive demand of theirs would ever be able to accomplish.

Treat mankind with honour, confidence, and liberality, as you would treat our mother earth, with a prospect of a fair return, I believe both will, in the result, answer our warmest expectations. Many difficulties, with regard to tithes, might be mellowed down by fair usage and rational enquiry. Rigid exaction adds mightily to the pressure, and depresses the spirit of the agriculturist. My interest in tithes, perhaps, might be considered of little value; it may be said, as this is the case, it is very easy to give advice in any matter, where the estate of the person himself will not be materially affected. In answer to such a remark, I can only declare, on my honour, that if I was Archbishop of Canterbury, instead of a poor vicar of a parish, my statements on the subject of tithes would certainly remain unalterably the same. As a proof of my sincerity, and as far as my property extends, I have most cordially complied with the plan proposed; and experiencing the benefits and comforts *individually* arising from its adoption, it would be ungenerous not to recommend a measure, that only waits to be *universally* tried, to estimate its real benefits. Tithes are an *undoubted* right; yet in *these*

times, if something could be devised to meet the wishes of the agriculturist, without breaking in on these rights and privileges, much satisfaction would be mutually afforded to all parties, as the nature of tithes would allow. But we cannot even hope for so desirable an improvement, unless certain prejudices are thoroughly overcome. All classes of the people, under the alarming exigencies of the day, the pressure of taxation, the dearth of bread-corn, and the scanty means of procuring it, should assist, concert, and contrive, by every possible means, in our several powers, to avert the impendent evils that surround us. Many of these evils might be averted by a fair commutation of tithe *only*. Our internal resources, with respect to grain, are manifestly defective at this moment; and if we allow this deficiency in a great measure to be occasioned by the present system of collecting tithes, a parliamentary regulation cannot too soon take place. Surely the object now becomes of vital consequence; so much so, that no *greater* can possibly engage the most serious attention of the legislature.

The writer of this essay has candidly considered the nature of, and the manner of making tithes less vexatious, and more accommodating to the tithe and land-holder; and the same candour must induce him to confess, without intending the slightest disrespect to any class of people, that he considers tithes, and their baneful consequences, whether in the hands of the church or the laity, to be equally ruinous, under their present system, to the agriculturist, *individually*, as well as to the *country* to which he belongs. These arguments and opinions are made with the purest intentions, solely to give a fair and impartial view of the subject of tithes; to countenance any mode of peaceably adjusting all difficulty, originating in their claim and collection, to the quiet and comfort of all parties. If the plan I now adopt in my own parish may not be esteemed perfectly fit for general use, I rather think, if the experiment was only made in most parishes, it would be found to produce the most essential benefits to the community. As to myself, I am convinced my estate in the church is greatly encreased by the fair, open, and liberal way I have confided in my parishioners, to what it would be, in the strictest exaction of it, in taking it in kind. Nor do I entertain the least doubt, fully knowing the general temper and disposition of my countrymen, but that they would rejoice to meet their clergy on the same footing; would rejoice to take them by the hand and forget all grievances; would rejoice to return to the forsaken churches: harmony would ensue—division cease. These are the blessings

that would flow from such a procedure in a *moral* point of view; in a *political* one, they would still be greater—a firmer establishment in the church, in the state, —a constitution that nothing would shake—a spirited and much extended husbandry: a thousand domestic comforts would crown our endeavours, and bless the labours of the land.

The design of these observations, on this particular subject, is to shew, 1st, That tithes taken in their present shape, have a natural tendency to check tillage, and increase pasture, which must operate amazingly in reducing our crops of grain, and is one great cause of the necessity of enlarging our importation; and, secondly, to recommend such remedies, and excite the legislature and tithe-holder to search them out immediately; and, when found, to courageously adopt them. Blackstone says, that Lord Burleigh, treasurer to Queen Elizabeth, observing how greatly the value of money had sunk, and the price of all provisions had risen by the quantity of bullion imported from the new found Indies, devised this method of upholding the revenues of the colleges. "The lessees should pay their rents "according to the price that wheat and malt should be sold for in the market next "adjoining their respective colleges, on the market day before the rent becomes "due." I quote these words only to prove the foresight and penetration of the ministers of Elizabeth, who in those days could so ably provide against the fall of money and the rise of provisions. The ministers of the present day, using the means they possess, might affect as easily some changes, with regard to tithe, as would give satisfaction to all parties, and surprizingly add to the revenue of the country. *Theory* may advance a thousand airy speculations, which on paper appear very feasible, and perhaps amusing; but one *practical* experiment, heartily pursued, in raising a bushel of corn where none grew before, or which is likely to effect the most desirable changes in the customs and usages in the general culture of the kingdom, is superior to them altogether.

CHAPTER II.

On Capital.

As the population of the empire appears, from the late returns made to Parliament, to be vastly increased, it is highly to be wished that the cultivators of the soil were multiplied in the same ratio. Want of capital was formerly considered as a

great check to our national improvement; but these latter days have convinced us that this matter is now better understood, and that wherever land is to be found, and fairly let, tenants with *capital* will not be wanting. Under the difficulties mentioned in the foregoing chapter, the skill and judgment of the farmer has of late been greatly improved; and if these could be by any means ameliorated, a superior management would still be expected among us. The turnip system, which is the foundation of all good farming, with a proper rotation of crops, has wonderfully assisted the efforts of the farmer in bringing *new* lands into a quick succession of cropping, and has equally renovated the exhausted state of the *old*. The Board of Agriculture has afforded the country much light on this particular subject; and other District Societies, following their laudable example, have had a surprizing effect, in giving premiums and lectures on the important value of this very productive root. Abundant crops in quick succession will produce capital; and where talent and capital go together, which is usually the case, double the breadth of land will be cultivated at less than half the expence that was formerly bestowed on the same. I know of no farm of any magnitude in this county vacant at present; if fifty were to be let, and the New Forest divided into estates besides, and put to the hammer to-morrow, I believe no tenant would be wanted, with a proper capital, to cultivate the *old* as well as the *new* lands, according to the nature or quality of the soil. Speaking of the New Forest, I shall beg leave to say something more at large on this subject in a subsequent chapter on the benefits of *inclosure*. With regard to capital, many reasons may be given why it is now easier acquired than formerly:—an improved husbandry on a greater scale, founded on the turnip system—the late high prices of grain—the facility of getting money from country bankers at a lower interest than usual—with other circumstances, have contributed more than any thing else to enrich the yeomanry of this kingdom. Another circumstance has very lately thrown an immense capital into agricultural pursuits, and that is, the unusual checks and restrictions on our *commerce*. Much capital has been withdrawn in disgust from commercial speculations, and employed in those of land. This also may contribute to rise lands to enormous prices, that have lately been given for them, of all qualities, throughout the kingdom. Merchants become farmers under the present embarrassment of trade; and bringing a large fund into this direction, must give a new impulse to the spirit of agriculture.

In my neighbourhood, two very large parishes have enclosed their wastes and common fields, to the amount of twenty thousand acres. The lands of both are a sandy loam, and the wastes of a very inferior quality, covered with heath. The *old* lands have sold on the average at more than one hundred pounds per acre, and the lettings of the same to three pounds an acre, while the *new* have been sold as high as twenty-five pounds per acre, and are now let in the same proportion. These undoubted facts prove, at least locally so, that capital is by no means wanted; and, I believe, so abundant is it at this moment, that if a great part of the wastes of the kingdom were now enclosed, both purchasers and tenants would be forthcoming. These high prices, in my humble opinion, further prove, that we have not a sufficiency of land under cultivation, to engage the capital of the country. In this district, whenever a sale of land, or of the tenancy of an estate, takes place, a number of competitors appear, and the sale and the lettings are generally made at the prices above stated.

If the large prices now given for land, are imputable to the high price of grain, and not to the excess of capital unemployed, this consideration alone should operate on us, as a very powerful reason to do away all restraints on the enclosure of wastes in the empire, to give full scope for our exertions on our own soils, which would enable us to exist without the necessity of importation. A more proper spirit of agriculture was never more alive than it is at *present*. It awaits only the removal of some impediments, and the adoption of some reasonable encouragements, *nationally* and *individually*, to feed ourselves most amply with our own resources, and make this country the garden of Europe. We are now, I believe, under many grievous restraints, *the best farmers in the world*, and are daily improving in spite of these obstacles; it is then the more to be regretted, that the wishes and inclinations of those, who are disposed to employ their capital, time, labour, and judgment, in raising the fruits of the earth, and on which every nation depends at *last*, should not meet with every proper encouragement.

It appears, then, if I am correct in my observations, that a capital is not wanted, but an increase of soil, sufficient for capital to work on; perhaps no circumstance could promise more comfort to a nation, than having the means of reducing the price of grain, at the same time affording a plenty for the support of the people: this seems to be our grand desideratum, and this desideratum is to be effected without a doubt, whenever an extent of soil is found adequate to the employ of

the superabundant capital of a country. No person, I think, can suppose our extent of soil too scanty for such an employ, if it was enclosed, allotted, and brought into the market. This great measure wants only to be accomplished; then may we hope, that a thousand of our difficulties would completely disappear.

The accumulation of farms is in a great measure attributable to the vast increase of capital. If we look round our respective neighbourhoods, we shall perceive many instances of poor little farmers, who, twenty years ago, could on a small rental scarcely keep themselves and pay their taxes, that now on a larger property are become rich and respectable yeomen. I know many of this description, who a few years back were just above the rank of a day-labourer, that are now worth from five to twenty thousand pounds: in short, I look on the yeomanry of this country to be by far the richest class of people, taken on the aggregate, among its inhabitants.

The advantages or disadvantages arising from the consolidation of farms have occupied much time in disputation; but, I think, the fairest way to set this matter at rest, is to appeal to living facts. Should we have seen the little miserable farmer exalted into the proud character of a yeoman, if he had still laboured on his 30 or 40 acres of land? Would the improvements in agriculture have been what they are now? Would the live stock of this country excel all other in the known world? Would our markets have been supplied even as they now are? These facts, with many others, that would only tend to lengthen this essay, might satisfy the most strenuous advocates for the advantages of *small* farms; that, considering the little farmer himself, or the *public* interest resulting from his occupation, no great benefits can now-a-days possibly arise from his contracted mode of cultivation.

The enlargement of farms has certainly been the means of bringing larger supplies into the markets of the kingdom: and larger supplies are undoubtedly required to meet the population. Many, however, have said, that a decreased population has followed the system of adding farm to farm, but the reality of the fact, under this addition, appears to the contrary.

I doubt myself the plausibility of the argument, that *small* farms raise *more* people; but I am confident of this, that they raise *less* food to feed them. A people then without a sufficiency of bread must be always in a very precarious state of existence: it is like an army or a navy in the same condition; all would soon perish, and be deprived while miserably existing, of all due power and energy

of action. Let us consider what has introduced this system of accumulating farms;—a thorough change in the state of things in general, which has brought on an extreme burthen of taxation and expense, which has eventually driven the little renter from his occupation; which has been added to the *larger* one to enable him to stand the pressure of the times. Besides, the landlord finding the same pressure, has recourse to some expedient to alleviate the load, and in doing so, he finds the reduction of his farm-houses and other buildings, contribute not a little to his ease and comfort: instead of fifty tenants, he reduces them to ten. Ten homesteads on any estate, where there were fifty before, attached perhaps to 30 or 40 acres of land, may be now thought sufficient to engage, even in their maintenance and repair, no small portion, *annually* from the rent roll of his estates.

Under every disadvantage, however, attributable to large farms, the accumulation still prevails, and little ones disappear. The change has been tried long enough to feel the merits of one plan and the demerits of the other, and the experience of the day must at last decide the point. Wherever we cast our eyes, do we not behold with pleasure, the spirited management of the great farmer, and deplore the miserable expedients the small one is usually reduced to, even to procure his *own* pitiable existence?

There may be, however, much good and great evils resulting from both systems, when carried to extremes—one may possess too much, another too little land, either for the good of the public or themselves. A farm from one hundred acres to ten, appears, *all things duly weighed*, to be the fairest proportions of promising success to the landlord, tenant, and the state.

The gradation of rent downwards, to the poor cottager with his cow and acre of land, is a great thing for this class of people, who, in my opinion, should never be without either. But this gradation under one hundred per annum seldom exhibits the true spirit of husbandry in all respects, answerable to the present demands of the nation. A flock of sheep, and a turnip fold to keep them, are seldom within the compass of a small establishment, while the greater may always possess these important advantages, and many others not to be found on, or to be purchased, by a smaller one.

If the continental exclusion of our commerce is to continue, a much greater capital must naturally be thrown into other channels; the difficulty of finding a safe resource of employ, must of course engage the greatest part in seeking lands to buy

and to cultivate. As long as the continent is enslaved, so long will these restrictions remain, disposable capital will increase, and land of all sorts, high as it sells at present, must inevitably be much higher. These embarrassments in our trade may eventually produce good out of evil, as it may induce us to enclose our wastes, purposely to employ the floating capital of the country. Necessity at last may oblige us to undertake a grand measure, which true patriotism and common prudence could never persuade us to attempt before.

CHAPTER III.

On Leases.

This article, like the preceding, has caused much controversy and disputation; and, after all, the benefits resulting from their being granted or not, must be decided by facts, rather than by words. The advocates for leases say, a sort of inheritance should be given to all farmers in their estates, as the only means of promoting a proper and spirited husbandry, to indemnify them satisfactorily for finding capital, labour, and judgment, and as the only measure the most promising to afford adequate supplies for the use of the nation. To this opinion I most humbly subscribe mine. Every possible encouragement should now be more particularly given to every species of exertion, connected with the agriculture of this kingdom; as such, we may consider leases, as the most prominent part of that encouragement, with certain covenants, adapted to the length of the term granted, and the nature of the soil the tenant is intended to occupy. The poorer the soil, and the more disordered by any former mismanagement the state of the soil may be, the longer the period of the grant should necessarily be extended. No tenant in his right senses could be invited to engage in the speculative occupation of new enclosed and newly broken lands, in any term less than twenty-one years; and a very irregular course of husbandry must be expected to be pursued on old lands of every quality whatsoever, where the occupier is either a tenant at will, or covenants for a contracted term. I know many real good farmers, tenants at will, who against their judgment and interest, crop their lands as long as they will carry. Some have then quitted their farms in this exhausted state, and entered others expressly with similar views of cultivation. The public and private injuries resulting from this narrow policy, are too well known to need any further detail; it is, however, a

lamentable reflection to think in these days, that the fair fruits of good land, and the talents of a good farmer, should be both sacrificed to this miserable system.

The landlord, the tenant, the nation, all suffer under this management; and the most superficial observer will see, that such faulty and imperfect proceedings must shorten in a great degree the growth of grain, and in the same degree increase our importation. Tenants at will, or on short terms, seldom enrich themselves or landlords. The farm taken on an uncertain footing, is worked as uncertainly; and lands let in this manner would rise to double in value, if a proper rotation of crops was followed. I think, that liberal landlords would make liberal tenants in most cases; and in those contracts where the prosperity of agriculture is the sole object, the mutual interests of both are usually secured. If we appeal to facts to support this assertion, we must refer to the practice of some counties, which would at this time have been wastes and rabbit warrens, if tenants had been without leases. All the expensive process of bringing wastes into culture could never have been undertaken, unless a proper aid and adequate term had been given to these speculations. If we ask, whether these have answered the expectations of both landlord and tenant, we have only to visit and examine these improvements in the several counties, where they have zealously been followed up, and the agriculturist would be gratefully repaid for his pains. I cannot refrain from mentioning two counties, which stand foremost in the annals of agriculture, although of inferior soils, producing superior crops to any other in the kingdom—these are Norfolk and Suffolk. As these counties take the lead of all others with regard to perfection in all good husbandry, so are they a powerful example of what may be done on the poorest lands, where the tenantry are encouraged and upheld by the grant of extended leases.

Both these counties are indebted *solely* to leases for their unrivalled culture; and it is a most pleasing reflection, not unworthy the regard of ll other counties, to know, that their respective gentlemen and yeomen have derived a wealth and a respect proportionate to their labours. To leases may be assigned the cause of their lands, which were not worth 2*s.* 6*d.* per acre, rising to 30*s.* and 40*s.* in their annual value; and to this cause, also, may be given this indisputable reason, why their farmers excel all others in the kingdom. The *Norfolk* system of farming is indeed now proverbial amongst us; and the more in general, in most soils, the cultivator adheres or departs from this system, the more or less will he rise in the scale of good husbandry.

The unfortunate prejudice against leases, evidently depreciates the value of land at present; a reasonable time for a rotation of cropping, a period fit for such preparation, and a fair return, equal at least to expenses incurred, is a right every tenant expects. But this cannot be the case where leases are withheld. The lands sink in letting under these circumstances, and are subject to a different course of husbandry, by which the tenant gains little, the landlord loses much, and the public a great deal.

The reasons I have heard against leases vanish, in my humble opinion, before the arguments in their favour, that tenants are unmanageable, and sometimes insolent, and always inattentive to their covenants. If this was always the case, which I believe is rarely so, and if it was, these abuses might be easily corrected by proper stipulations; can these have any weight against the great interests of the nation? These reasons appear trifling and nugatory, compared with the loss the nation sustains by leases being withheld. Prudent stipulations in all contracts are essentially necessary for the welfare of all parties; those in leases should be liberal and just; too plain to be misunderstood, and too firm to be evaded. Many late decisions in the Courts have taken due care of the interest of the landlord and have severely punished several tenants who have wilfully neglected to fulfil their covenants. An illiberal, an ungenerous renter, may take some paltry advantages, which usually never repays him for his pains, and at the end of his term, may more particularly injure his successor by irregular cropping: but a steward of an estate must be unworthy of his trust, and sadly deficient in his arrangements of a lease, that does not completely guard against any impositions. A tenant seldom robs his farm, setting his landlord out of the question, but he *ultimately* robs himself; and as in the case of all plunder and robbery, the man exists but a short time undiscovered, to enjoy the fruits of his injustice.

Too rigid exactions, in any agreements, are often very prejudicial; in the terms of a lease they are particularly so; and where they might be as rigidly enforced, they operate as a great check to many improvements, which even a tenant at will, without such restraint, might be inclined to adopt: therefore when leases are granted, they should be done so *judiciously*. All tenures held otherwise, that is on narrow and contracted principles, cease instantly to benefit the parties and the public in general.

I am inclined to believe, from all the reasonings on this subject, whether we

contemplate the real good of the landlord, tenant, or public, much material benefit must happen to *all*. Authorities have been given to prove and strengthen this assertion: sanctioned by these authorities, I must recommend the landed interest of the country to consider, that prudent and judicious leases are the greatest incitements to agriculture, and would tend vastly to contract our importation of grain; and would fix, on a more solid foundation, our national wealth and power. In antient times leases were invented to prevent unreasonable abuses, avowedly also for the security of farmers, and the consequent improvement of tillage:—The same wisdom that induced our forefathers to introduce these instruments of protection, which seemed also to have in view not only the mutual interest of landlord and tenant, but the *general* welfare of husbandry besides, should urge us, in these days, not to reject so wise a measure. The study of agriculture, which has mightily prevailed since the days of old—an increasing population, with means unequal to feed it—a dependance on other countries for this defect, which for many reasons may become unusually severe, call on us *most imperiously*, at this moment, to retain an usage, regardless of any little narrow selfish prejudices, that has done more, from the remotest period to the present, in recovering land from a state of nature, in *this* country, as well as in others; and when so *recovered*, has been the means of producing from these very soils, the most abundant crops for the use of the people.

CHAPTER IV.

On Enclosures.

It will be very difficult to say any thing new, or perhaps worthy of attention, on this subject, as every point essentially tending to promote the public interest, has been already communicated, by the industry and zeal of the Board of Agriculture. It will be equally difficult to suggest any opinions or arguments that have not been repeatedly pressed on the observation of this nation, by its warmest recommendations of a *general enclosure* throughout England.

Motives of self-interest have hitherto superseded all other considerations; and when it is too late, those who are more particularly bound to regard its admonitions, will see the folly and imprudence of rejecting them. Every County Report received by the Board of Agriculture on this subject, uniformly recommends the measure;

the substance of these have been officially reported to those who have not interested themselves sufficiently in a work, in which the welfare of all ranks of the people is at stake. Shall a few petty fees, or the private emolument of any man, be a paramount consideration to the existence of the people? Shall twenty-two millions of acres of waste remain in a state of nature? Shall an encreasing population feel the want of their daily bread, because a perquisite of office should be more or less? In God's name! let every demand be handsomely satisfied to the fullest extent and wishes of the several parties, out of the purse of the nation, rather than any material obstacles should oppose the whole extended culture of the kingdom.

The trouble and expenses of procuring the legislative means, as well as the common legal abilities, are too well known to need any illustration; suffice it to say, by a very narrow policy, these difficulties, *in limine*, shut up the avennes that directly lead to one of the grandest measures of any government. Bills have been framed, and other devices have been thought of, to clear away every impediment, but in vain; the sweets of office seem to be of higher moment at present than the sweets, that flow from an expanded cultivation. The day, however, presses onward, when these considerations will appear as trifling indeed, and will vanish as chaff before the wind, while a *nation* is asking for bread. The effects of scarcity, if ever these should visit us again, will perhaps show us these things in a proper light: then it may be too late to remove these impediments, so very injurious to an increase of food sufficient for all our necessities, and which might have been so very easily removed many years before: Wheat, or other grain, equal to our *present* wants could not be raised, if all obstacles were done away, *immediately*, and every acre was enclosed to-morrow.—Some years must now pass over us, before we should find ourselves independent of other countries, with respect to grain; and millions of hard cash must be expended for years to come, as they have been many years past, but *now* without any barter or exchange, to meet the common exigencies of this nation. However, it is never too late to see our errors, if we have resolution to amend them; and as a preliminary step for such an improvement, every national and parliamentary facility should be afforded the people, to give instant life and vigour to so glorious an undertaking. It is a melancholy idea, that the best farmers in the world, with the best means in their power, if fairly employed, should now be fed by *France!!!* And what is still more shocking, that a load of wheat was purchased last year in *that* country for £8.; imported into this, and sold to the people, from £24. to £28.

The markets of this country were supplied with this wheat; and though of very inferior quality, the importer and factors engaged in the concern, contrived to sell it at prices almost equal to the best of our own. I know, from one of the parties, that this wheat was purchased in France, on the average, at £8.; and some of the best commanded an immediate sale. I mention this circumstance, as a proof that these people can grow a load of wheat at half the expense we can; and that we are happy to get it, of any quality and at any price, to make up the deficiences that every where in this nation too plainly appear. Again, we should consider that no exchange but gold is made for this article. No trade, no manufacture, is aided or encouraged by this mode of barter; and, after all, they would much rather give us stones to choke us, than bread to feed us, if they did not conceive it to be part of their grand scheme to cripple our finances. Suppose, for an instant, their charity or caprice should even withhold these supplies, where are you then to procure them—is America to be depended on?—Trust not *either* in the one or the other—confide in *yourselves alone*—and hide not those great talents which Providence has given you, in a napkin, useless and unimproved.—Set to work with a hearty good will to cultivate every foot of land in the kingdom.—Let every legal facility be given. Let every parish be invited to enclose, by the encouragement even of national premiums, rather than we should any longer exist at the mercy of our most inveterate enemies. We cannot say we have not an extended field to work on. Look at the wastes of the kingdom. Yorkshire alone, from Mr. Tuke's survey, contains 849,272 acres of waste; 495,435 of which are fit for cultivation, and the remainder, 353,837 acres, are fit for planting. If we go for further information to the Reports on waste land, besides this great county, we shall find them to amount to 22,107,001. If we calculate on one half of this quantity as capable of carrying grain, what an inexhaustible fund is open for our exertions! What a shameful reproach to our industry and wisdom, that with these great resources within our power, Great Britain should be absolutely reduced to the necessity of importing that, which with common prudence and foresight we might raise at home. Capital is not wanted, which has been observed before; besides, if it was, the millions exported by Government for corn, would go in aid of reducing the wastes of the kingdom. If labour was wanted, the unoccupied military, with a little additional pay, would be another great assistance in their immediate application to all the purposes of husbandry. To expedite so grand a measure, certainly extraordinary

means must be found, and those means wisely adopted. Neither can it be supposed that our government would deny all proper assistance, or would any class of our people shrink from their several duties, encouraged by such an example, to effect an object that embraces the ultimate good of the whole. A fair proportion of wholesome food is the *vis vitæ*, the very sinews of labour; without it, what is an army or a navy? All will soon lose their superiority, if they are fed too scantily, or rest only on the precarious subsistence afforded by their enemies.

If Great Britain is to wait until the rights of individuals, as to manors and other lesser privileges are to be satisfactorily adjusted, our inveterate foes may swallow us up before that period arrives, and we may be *compelled* by them to cultivate those very wastes, we refuse to cultivate ourselves. A proper arrangement has been frequently suggested, by the earnest attention of the Board of Agriculture, to this momentous concern, as well as by individuals, to satisfy any legal niceties; which, indeed, a petty or a quarter sessions, or even a higher jurisdiction, may settle with the least possible expense. In the plans submitted to the public, every facility is pointed out, every useless expense obviated. It only remains—to rouse ourselves and *consider*—to shake off our inveterate prejudices and habits, which are our greatest foes, before we are starved into the adoption of measures that have been so often urged in vain by the truest friends of the state. Whenever we are pinched by necessity, and perhaps it may happen before the next harvest, no just reflections can be thrown on those whose province it more immediately is to attend to our agricultural concerns, that *they* have not, by the most anxious and patriotic zeal, exhibited most fully, in their words, writings, and deeds, an apprehension of dreadful embarrassments with regard to grain. If the same zeal had prevailed in other quarters, who have ample power to enforce any regulations as to this point, we should not exist under the constant alarm of too scanty a supply.

Two years of scanty supply, bordering on famine, have lately endangered the lives of the people: these are awful mementos, deeply impressed on the minds of the present generation, to be too easily forgotten. Still with these horrors in our recollection, we have done very *little*, if an unfavourable season prevails, to avert the return of similar calamities.

If Providence should at any time permit these evils to revisit this land, to whom will the universal blame attach? to those who perpetually advised a remedy, or to

those who as constantly neglected to use it? And if laws are to be made, and to be carried into execution with proper effect, for the immediate benefit of the community, no law can possibly merit the attention of the senate more than one, that would most effectually enforce by fine, by penalties and rewards, the culture of the whole of our wastes. At this crisis, trifles are to be disregarded, promptness of execution is the thing required, and this only will ensure success; and the minister who accomplishes such a national advantage, deserves, most assuredly, "the monumentum ære perennius."

I have no interest, but that of serving my fellow creatures, in representing these things in a strong point of view. If a scarcity or a famine happens, I shall suffer with the multitude, it is true; but I shall reflect, with no small satisfaction, that I have done all I could, within the compass of my feeble power, to inspire those, to animate them with a proper spirit—those indeed who have the superiour ability to prevent such tremendous evils.

Extreme caution and foresight are too often used in matters of inferiour moment, whilst the vast consideration of making this country less subservient to others, and more independent in its own resources, occupy but a small portion of our labours. By the statute of Merton, and other subsequent laws, "The lord of the manor may enclose and convert to the uses of husbandry, as much of the waste as he pleases for tillage and wood ground, so he leaves *sufficient* common for the commoners, according to the proportion of their land." The word *sufficient*, in this statute, is liable to many interpretations; so questionable is it, that it cannot be easily defined; and if it was enforced, it would produce endless litigation between the lords and the commoners: on this account it seems to have been disused. I have quoted this part of the statute only to show that our forefathers, as far back as Henry the Third, in the year 1235, made these wholesome provisions for the improvement of their commons, and on which foundation all the subsequent laws, on this point, appear to have been constructed; but the original and copies have been all hitherto extremely defective, even to the present time, in not giving full powers, without any shackle or restraint, of obtaining the thing intended.

The orders of the House of Commons, with respect to enclosures, are highly proper, as far as regards themselves; so is the duty of the commissioners, and of the parties interested; but the delay, the difficulties, the enormous expense, accompanying the execution of the act, are sadly detrimental to the important

measure of *General* Enclosures. Two parishes in my neighbourhood have been lately enclosed; but before the award was signed, the expenses of both amounted to near twenty thousand pounds; besides, five years, in point of time, were occupied before the whole of the business was completed. The lands divided and allotted may amount to seventeen thousand acres, and most amply repay the parties and the public; but we cannot help regretting, that so much money and time in these cases, as in most others, are expended, when we must suppose other plans might be introduced, to effect the same beneficial purposes, at one quarter of the expense of either.

However, any departure, at almost any expense to the public or individual, from old and erroneous systems, must at all times be most desirable, but *now* more particularly demands our notice. A change that will enlarge our growth of corn, must consequently decrease our import; and, by operating both ways, add considerably to the revenue of the country.

Foreigners, and particularly France, have lately seen the advantages of husbandry, and amidst their exertions have not forgot the plough. Societies are formed in every district to improve the people in new methods of managing their soil, enclosing their wastes, and in increasing every where the fruits of the earth.

These changes have probably enabled them to spare us some of their superfluity; and while they feed us, this idea alone should shame us into an imitation of their conduct. They are supporting their own people, and feeding the children of the stranger. With the best resources in the world, if *rightly* used, we submit to this degradation. The superiour management and industry of one or two counties is not sufficient, by the overplus, in their growth, to make up the deficiences of others; therefore, while these things are suffered to continue, we must still remain an importing nation, exposed at all times to a thousand evils.

Perhaps it will surprise those, who are regardless of this important subject, to hear from the official papers presented to the House of Commons, that the total amount of wheat imported into the several ports of Great Britain, in the year 1810, was 1,387,020 quarters; of which 334,836 were from France, 189,160 were from Holland, and only 34,829 from America. With respect to flour, it appears that we did not import more of that article from the United States, than we did from the countries with which we are at war. Facts like these, coming from the highest authority, no person can doubt, and sufficiently and sorrowfully prove to

what an extent Our subsistence is drawn from foreign markets. I have before given my opinion, most sincerely, as to the remedy of the evils—it is fully and fairly within our reach, if we have the spirit and wisdom to apply it. My anxiety for the instant adoption of means of *national* relief is so urgent, that I cannot resist repeating it again and again most emphatically, however the patience of my reader may be exhausted by the length of this essay. It is then, *The immediate cultivation of all the unenclosed wastes in Great Britain, which will most effectually preclude the necessity of import!!!*

Large sums of money, or capital, appear to be disengaged at present, occasioned by our restrictions in trade. The enclosure recommended would display a grand field of encouragement and employ, to invest a floating and unoccupied property. This might be made a mighty engine of national improvement, if properly directed, to accelerate, in every point of view, the immediate culture of our wastes. If commerce should revive and flourish, part, if not the whole of the sums so employed, might revert into its old channels, after having been instrumental in bringing about so much public good. It may be asked, how capitalists may be indemnified in the purchase, and in the breaking up of allotments? I can answer, from what I know of these speculations, where they have been judiciously bought, and as judiciously cultivated for grain, or planted suitably with trees, they have fully repaid the expectations of the cultivator with an adequate interest; and when let to tenants, under proper restrictions, have seldom failed to produce the same. A wrong application of soils, with a worse management, has greatly injured the cause of enclosing. Good husbandry, on sound and prudent principles, will work wonders on any soil. A good farmer on the sands of Norfolk will produce more corn, than a bad one will in the famous vale of Evesham. If this be true, as I think it is, which may also be confirmed by many examples within our knowledge, where one tenant, solely by the misapplication of his powers in the conduct of his estate, has starved himself into a goal; and his successor, by a different scheme of management on the same estate, has made his fortune. These are powerful arguments, whether the revenue of the public or the individual be consulted, for the government of Great Britain to encourage, as much as possible, the *study* of Agriculture, hitherto not appreciated as the science truly deserves. After all, the other powers of Europe begin now very wisely to discover, that all the real good and substantial welfare of a people depend more on the due observance of the most prudent

methods and wisest rules in the cultivation of the earth, and which many politicians formerly have disputed, than all the schemes and plans they have been able to invent for the happiness of man individually, or for the general good of society. Clarendon, after describing the various advantages of this country, thus concludes the picture: "But *all these blessings could but enable, not compel us, to be happy. We wanted that sense, acknowledgement and value of our own happiness, which all but we had; and took pains to* make, *when we could not* find *ourselves, miserable.*"

THE CONCLUSION.

THE Board of Agriculture, always alive to the wants and necessities of the State, was induced probably to inquire into the causes why *this* kingdom does not at present supply itself with bread corn? and what are the surest and best means of supplying itself, without the necessity of importing foreign grain?

I have taken some pains, in the preceding chapters, to consider these questions. The best and surest means of enabling us to overcome these difficulties, may be known even to the most inattentive observer, if he will only bestow a small portion of his reflection on the agricultural state of this kingdom. The prejudices and impediments to be removed, and the universal encouragements to be given to the spirit of agriculture, as far as these can possibly extend, have been well weighed, and as firmly recommended to the serious attention of the public. No means whatever, in the opinion of the writer of this Essay, can be devised to reduce our import of grain, and produce enough on our *own* soils to feed a rapidly increasing population, unless the import itself is destroyed by the removal of those unfortunate checks that have given it existence; and until this removal gradually takes place, no essential good can be expected for the comforts of the people.

All parties seem at last to be of one opinion, (excepting those few whom bigotry and prejudice have so completely blinded, as to set a higher value on themselves and their own interest, than that of the public), as to the absolute expediency of amelioration in every *article*, I have ventured to discuss; in the discussion of which, I have plainly stated the causes of many of our evils, and strongly recommended a temperate change in the old systems the most likely to produce the greatest beneficial effects. Examining the nature and extent of our difficulties *impartially*,

is in some measure to conquer them; but to subdue them completely, we must all meet them boldly and unbiassed. With regard to the article of enclosure, in some late arrangements, cottagers have been deprived of their cow and potatoe-ground, which have eventually thrown them on the parish. This circumstance alone, within the circle of my knowledge, has contributed very much to retard with us the inclination to enclose. Every man is highly interested in keeping the poor from the parish books, and as comfortably as possible in his own habitation; but this very desirable measure has been defeated by the ill judged conduct of some commissioners, who, forgetting the comforts of the poor, have most clearly forgot the real interests of the parish. I am one of those that think every poor man in the kingdom should have enough land just to keep his cow, and for the use of his potatoe ground; and where this has been invariably the case, few instances have happened, that poor people, in the severest times, have been maintained by the parish. To satisfy the objectors to *all* enclosure, as to the points of milk, fuel, and potatoes, which most certainly are the grand desiderata in the poor man's family, I must recommend to their perusal the observations of Sir G. O. Paul, Bart. on the General Enclosure Bill, who humanely remarks, "would it not be rather advisable, after admitting the right, and enjoining the commissioners to consider the compensation, *wholly to generalize their powers*, and enable them to adopt such means as may appear most suited to *local* circumstances." If this wise precaution had been exercised in all enclosures that have taken place, neither the poor themselves, or the parishes, which, in consequence of less prudent regulations, have been reduced to the necessity of supporting those who before maintained themselves, would have suffered in the severe manner they have done.

It is highly gratifying to every agriculturist, to see the exertions of some gentlemen of the first character and consequence, constantly dedicated to this particular study. By the diffusion of their knowledge, all our impending difficulties, in due course of time, would be generally considered by all classes of the people; and when perfectly understood in all its bearings, would unite, waving every little petty private consideration, in the execution of every possible remedy to promote the public interest. We may indulge a hope, that as these great questions I have presumed to write on have been agitated repeatedly, they are now likely to be seen in a proper point of view; and those immediately concerned in the beneficial changes, arising from this illumination, will most readily acquiesce. The nation

expects, as our prejudices wear away, some decisive proceedings to take place. The people look forward with certainty to some period, and I hope they will not be disappointed, when a due regard will be paid to the improvement of all the subjects under consideration; in doing which, with the least possible delay, the legislature will meet the wishes of all.

The importance of the several subjects has imperceptibly extended these remarks beyond the bounds intended in their examination. The exaggerations of any fact, or reflections on any body of men have been avoided. The sole aim has been *Truth;* and this *must* ultimately prevail, from whatever quarter it has been, or may be opposed.

There never was a period that called more imperiously for every friend of his country to stand forward, and offer some remedies that may be improved by men of superiour talent than the present; the embarrassments in commerce, accompanied with a crop under the average, will require much wisdom and foresight in those whose duty it specially is, to alleviate the miseries that threaten us. This year can only afford us such crops as we now possess; at any rate, and at any price, under the present state of the continent, no dependance on the *Import* of grain can be securely made: we must begin even now to husband our resources with the greatest frugality; another year, if we survive the calamities of the present, will teach us, but not without much sorrow and bitterness of heart, I am afraid, the folly of depending on any importation, while we have such immense wastes inviting a general cultivation.

It is not very difficult to foretel what must follow, if this importation is suffered to continue. *Foreign* supplies may fail us in a thousand ways, which our *Home* supplies cannot, unless Providence should destroy our crops; but better is it by far to rely on the mercy of Heaven, than put our trust in the mercy of those nations, whose most fervent wish is our *utter destruction.* The most alarming consideration is, that we appear to be almost satisfied with the present state of things. We seem to be insensible of our approaching difficulties. It is highly improper to disturb the feelings of the people with an idle and unfounded alarm; but it is equally imprudent not to provide, by every precautionary means in our power, against any imminent danger that may threaten us. Who can say, who speaketh without hypocrisy, that we are not struggling with innumerable difficulties, many of which are created by our own mismanagement, in not using all the means that

God has bountifully given us, in neglecting to value rightly such tracts of valuable land, still a shameful monument of our folly, remaining in a state of nature.

As to open fields that have lately been enclosed in this part of the country, they have doubled their crops of every kind, although 15*s*. per acre was the average rent of this land when in *common*, which now is advanced to £3. per acre. The farmers are doing much better in general than they did before; and some of them, who have had the courage to abolish those barbarous customs used by our ancestors, are rapidly improving their fortunes, as well as their estates. Even at this increase of rent, the demand for farms prevails; which proves again, as I have before observed, that land of any sort, *new* or *old*, and not *capital*, is wanted, to employ the efforts of the rising generation.

With regard to new lands, or commons, that are lately broken up, these sell or let with us in the same proportion. A few freeholders, of whom I am one, consented to enclose a common last year, and to divide and allot it among ourselves, time enough to plant it with potatoes. Having old lands, as much as I could well attend to, I preferred selling my allotment in the rough, without any expense incurred, which I did to one of my neighbours at the rate of £27. per acre. From this common I never received a penny profit before, neither did any of my fellow freeholders; a few cottagers, until now, received the trifling advantages of its pasture.

This enclosure, mutually settled between ourselves, at the *enormous* cost of £6. 3*s*. 1$\frac{1}{4}$*d*. which was our surveyor's charge for measuring the common, and who was a country workman, without the pomp and parade of a legal commission, has perhaps been the means of bringing into the market a thousand bags of potatoes. With respect to the culture of the potatoe on this common, I must not forget to observe, that a fair field of the different modes of cultivating this valuable root, in the different allotments by their respective owners, was offered for my remarks. Some were planted without any manure, and badly ploughed; some with different manures, with the spade and mattock; but I invariably saw those allotments produce the greater produce where the greatest manure and labour had been bestowed, in proportion of twenty to sixty or seventy bags per acre; this variation, as in all other crops, depends so very much on good management, and was fully exemplified in the quantity of product arising from their different labours. The sluggard and the drone must be content, and not murmur in being

repaid with a tenfold produce in proportion to his toil, while the industrious shall receive an hundred fold into his bosom. In every point of view, *Potatoes* stand high in the scale of our agricultural improvements. As a preparatory crop, as reducing the consumption and the price of wheat, consequently reducing the extent of our import, without the potatoe, what would *now* be the annual supply of grain wanted? The calculation would be frightful. Our markets tell us very plainly when the crops of potatoes are plentiful or not. Many poor families use them twice, and some thrice a day, of course little wheaten bread is wanted to support them. A scarcity of potatoes certainly affects the price of wheat: this root has now become its succedaneum: and when the substitute fails, the article it was intended to supply increases rapidly in value. The wet summer injured our potatoes greatly; locally speaking, this may occasion our rise in wheats, in some measure, as connected with their produce.

As the culture of the potatoe is next in consequence to the culture of wheat, I have taken some pains, among other experiments, to ascertain the positive effect of *different* manures on the product of potatoes, in the same soil, with the same species, and under the same management. The result may not be uninstructive to the public; I will therefore beg leave to submit the table of the experiment to the notice of the Board. The sort planted was the *white* round, on the 10th of April, 1811, on a clean sandy loam, well pulverized, in rows two feet asunder, twelve inches distant in the row, and six inches deep. As this root is now daily considered more and more to shorten our consumption of bread-corn, I was willing to see in what degree the *eye alone* would yield its product; and if it would produce as much as the *whole* root, a great quantity of food might be saved for the people. The result also of this experiment is for the consideration of the Board.

Table of Experiment with the White Round Potatoe.

No. 1	was planted	with sheep's dung,	product	one bag and half per lug.
2	——	with garden rubbish,	——	one bag and 3 gallons
3	——	with old rags,	——	one bag and half
4	——	with cow-dung,	——	one bag and 3 gallons
5	——	with horse-dung,	——	one bag and 3 pecks
6	——	with coal ashes,	——	one bag and a half

No. 7	was planted	with turf ashes,	product	one bag, 3 pecks, 1 gallon
8	——	with turf dust,	——	one bag, 3 gallons
9	——	with mown grass,	——	one bag, 2 bus. 2 peck. 1 gal.
10	——	with hen's dung,	——	one bag, 2 bushels
11	——	with pig's dung,	——	two bags and 3 pecks
12	——	with mud from a river	——	one bag and 1 bushel

Table of Experiment with Eyes only of the same Potatoe, planted on the 12th of April, 1810, *on the same Ground with the same Manures.*

No. 1	was planted	with sheep's dung,	product	one bag, 1 peck, per lug.
2	——	with garden rubbish,	——	one bag, 1 gallon
3	——	with old rags,	——	one bag, 2 gallons
4	——	with cow dung,	——	one bag
5	——	with horse dung,	——	one bag, 1 gallon
6	——	with coal ashes,	——	one bag, 1 peck
7	——	with turf ashes,	——	one bag, 1 gallon
8	——	with turf dust,	——	one bag
9	——	with mown grass,	——	one bag, 2 bushels
10	——	with hen's dung,	——	one bag, 1 peck
11	——	with pig's dung,	——	one bag and a half
12	——	with river mud,	——	one bag

On the careful examination of this table, we may easily perceive which is the most forcing manure. The pig's dung, old rags, and the coal ashes have the superiority over the others; but the pig's dung outstrips all by almost double the quantity. The *eyes* produce a respective quantity with regard to the manures, but by no means equal to the *whole* root: I found them in digging much smaller also. This experiment will not only serve to prove what the most valuable manures are in the cultivation of this plant, but will convince us that the food saved in planting the *eyes only*, cannot be compared with the increase of produce in planting the *whole* root; besides, if we take into the account not only the loss in product, but the labour and manure, rent of land being equal in *both* experiments, no person will ever adopt the planting of the *eyes*, when he has seed enough to set either a *half* or a *whole* potatoe.

Potatoes and turnips I estimate as the two most invaluable roots that have been discovered among us; each seen in its proper light, and in which they seem more and more to be considered, has its separate and inestimable worth. The *first* is the poor and rich man's friend; supplying the place of wheat for the one, and ameliorating the soils of the other; the *latter* as a means of forming the sheep-fold on old as well as new lands, which is the grand preliminary step to the successful issue of every species of cropping, if a proper rotation is observed. These then are treasures indeed; the one affording, in all seasons, a solid succedaneum for the staff of life; the other, in all situations, an inexhaustible fund of manure. I have lately seen the surprising effects of turnips on some common fields, that have been lately enclosed, and where never any grew before; the crops are doubled, the rent tripled, and the tenants thriving in the same proportion. It would be superfluous to say more on these two subjects; a thousand instances are known, beyond all doubt, to establish them in the opinion of every enlightened agriculturist, as the foundation of all good husbandry.

The introduction of spring wheat in this district is another great improvement, tending to increase our resources and *decrease* our import. I have used it to fill up the vacancies of my winter's wheat with great effect; and others have planted it after turnips the first week in May, instead of *barley*, and it has generally, taking the grain and straw together, turned out a more productive crop. We conceive, from experience, that spring wheat is less subject to the diseases that usually affect the autumn wheat; although in districts in the neighbourhood of the sea, as is the case with us, it is observable, that all crops of grain are usually exempt from those disorders that materially injure the grain of inland counties. The south-west wind, in July or August, in some exposed situations, is more fatal to the farmer, than smut or mildew.

There are matters of minor consideration, that stand in the way of our national improvements in husbandry, and eventually are the means of increasing our import. These claim our attention in some degree, though not equally, perhaps, to those points that have already been discussed. *Thatch*, that is applied to the covering of our buildings, may not strike the superficial observer as the cause of an increase of importation of grain, and a check to the progress of agriculture. To prove this position, I shall only mention the millions of tons of straw, which is now lost as a manure, and which ought to be used as provender for rearing a greater

stock of cattle bringing more land into corn, and in furnishing the markets with thousands of cattle more than at present. This practice alone, however trifling it may appear to many, is depriving this country annually of an immense quantity of meat and of corn. Slate is *now* prevailing as a substitute; and when we calculate on the danger of fire, double insurance, the public and private loss, and every other expense incidental to thatching, slating on all our buildings cannot be too much encouraged.

Vermin of all kinds, on the aggregate of the kingdom, is another serious consumption of our annual produce. Take only the loss, on the average, at two quarters of grain per parish, multiply this by ten thousand, which is about the number of parishes in England, and then imagine how many thousand of the people might be maintained by the saving of this grain, so destroyed! It is an object of our industry to procure good crops; and this object should lead us on further to dispose of them wisely, in the aid of future husbandry, with regard to the increase of manures, and to protect the grain, when we have raised it, from *all* depredations.

The whole intention of the writer of this essay is to prove, that the full means of enabling this kingdom to supply itself, not only with *bread corn*, but with every other article that men stand in need of, sufficient indeed for all our REAL wants—are now, at this moment, with due consideration in their several applications, perfectly within our own power and compass. It is our folly and luxuries that not only *compel* us to *import* grain, but every thing else. We have land sufficient, if all the impediments were removed, to furnish us with the greatest possible of all sorts of produce, fitted to supply our *natural* wants. It is our *acquired* wants that lead us to an import, that if not checked, must eventually destroy us. The native wool of the country, though improved by the Merino, is not good enough to clothe us!—the beverage made from our own soil is beneath our appetite! Let the man who wants a better coat than England can give him, depart—let the man who disdains to drink his native beverage, and cannot exist without claret or champaign, resort to the land where it grows—but, let us hope, both the one and the other, will never return. At this time to be solicitous about these things is degrading to an Englishman. Placed by nature in the midst of lands equal to all the comforts of man, we depend on foreigners for our VERY BREAD. Away then with every obstacle that opposes our real welfare—away with prejudice, that retards our improvements.—Open the book of agriculture to all! Let the science prevail, and

stimulate us to deeds of renown in the fields of Agriculture, as in the fields of Mars. From *her*, nations have sprung up, flourished, and been established. Let us not, by neglecting the inexhaustible means of preserving this nation, with every ability within ourselves, if our public spirit, if our patriotism will permit us to fairly employ it, rest on others for our support. Action, energy, incessant application are only wanting to make US TRULY INDEPENDENT in food, in raiment, in every *Essential*, justly contributing to the happiness of man, in the fortunate periods of peace, or in the severer times of protracted warfare. Let Englishmen, who usually excel, in what they heartily undertake, as far as their several opportunities and abilities extend, give due attention to these reflections, as much indeed, as they immediately deserve, continually presenting to their minds, this instructive admonition and impressive motto, That he who avoids the mistakes of an enemy, gains from thence the surest advantage; or, in the language of the classics—

"FAS EST ET AB HOSTE DOCERI."

Sopley, May 20th, 1812.

No. XXXIX.

An improved Hay-rick. By A. H. Chambers, *Esq.*

Stratford Place, March 14, 1812.

Sir,

Observing the annual losses sustained by hay farmers throughout England by their ricks taking fire, especially round the metropolis, I am induced to lay before the Board of Agriculture a plan of a hay-rick, which I have used for some time with considerable success; and last year formed a rick of clover (90 loads), which were carried within the seventh day after cutting, and got on the rick within a very few days, and not stained, by which I conceive I have derived much advantage. The idea, I acknowledge, is not my own; for I took it from the distiller's patent for working in summer, making use of a worm through the wash, by which means they keep it at a regular temperature. The application only is novel, the which I submit to the Board for consideration; impressed, as I am, that its general adoption would be most beneficial, and more than equal 20 per cent. of the present expense attending hay-making. The accompanying ground plan will shew the gutters and channels through which the air passes: being open, the air is constantly circulating through the center of the rick, admitting the dense air to check the fermentation, and throwing off the evaporation more freely.

A channel or gutter a foot wide and deep, is cut through ground marked out for the rick, and two across, which is thirteen yards by nine. Two chimneys are introduced like the common hay funnels, only mine go full home to the earth, which being drawn up as the rick is forming, and the channels previously covered with faggots, except where the chimneys are placed, leave them open at all points; and let the wind blow from what quarter it may, the current is uninterrupted.

The objects to be attained are various. First, the hay may be carried at least one day earlier, by which it is less exposed to weather. Secondly, there is a day's saving of expense in labour. Thirdly, the weight is greater; for if the hay is made an hour longer than is absolutely necessary, so much is the loss of weight by evaporation; and it is of the first importance to retain as much sap as possible in

the hay, so that it is not heated to injure its colour, being more nutritious. By this means the exhalations in the summer are not suffered in the same manner as in other hay-ricks, to accumulate, which is one of the causes of ricks taking fire.

The chimneys are of course kept open until the heat has subsided, when they are thatched over.

I have the honour to remain, SIR,

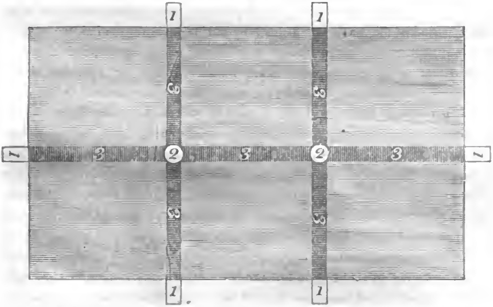
Your most respectful and obedient servant,

A. H. CHAMBERS.

P. S. In corn-ricks the benefit is equally great.

The Right Hon. Sir John Sinclair, Bart.
&c. &c. &c.

An improved ground Plan of a Hay-rick.



1. Opening of the trench one foot deep, ditto wide.
2. Funnel or chimney to be kept open while the rick is making, and until the heat has subsided, when it may be thatched.
3. Channels covered with faggots.

No. XL.

On the Trade in Wool and Woollens, including an Exposition of the Commercial Situation of the British Empire.

Extract from the Report addressed to the Wool Meeting at Lewes, on the 26th of July, 1809, *by the President,* John *Lord* Sheffield.

SINCE I had the pleasure of meeting you last year, there has been a great variation in the price of wool. Previously to that meeting, in consequence of the distrust which arose in respect to the American States, and the disordered state of the continent, our manufactures suffered a depression, more considerable than at any former period of the war; and assisted by much misrepresentation, the price of wool was kept down; but towards winter, the price rose rapidly, and afterwards to an extent never experienced before. I stated at our last wool fair, and in confident terms, that such would be the case. It was not difficult to foresee it; and I particularly represented, that there was no foundation for the supposition that the manufactures of the finest wools (now principally under our consideration) were essentially prejudiced by the war, as the sale depends almost entirely on the home market, and comparatively very little on the export to the continent of Europe. I wish to bring to your recollection that *the home demand is the great support of all our manufactures!* Little argument can be deduced from the extravagant prices of wool, during the greater part of last winter and spring. It was evidently occasioned by wool-dealers speculating on the scanty supply of Spanish wool, and on the article being in few hands; however it is certain, that the value of wool is much higher than it has been of late years. With respect to our woollen trade in general, there is no doubt that it will be considerably better than it was last year. The American Non-importation Act, which was in a great degree ineffectual, is at least suspended for the present; a great exportation thither now takes place. Several other channels are found for our manufactures, and whatever was deficient in the demand for them in preceding years, will be amply compensated by the future demand; for they must be had somewhere, and the manufactures of the continent are certainly greatly reduced, and prejudiced by

revolution and war. The principal apprehension is, whether our manufacturers will be enabled to procure an adequate supply of the raw material. Whatever check or decline takes place in the excellent manufactures of fine wool in the west of England, does not arise entirely from the scarcity and high price of Spanish wool, but partly from the high wages, which are likely to transfer the manufacture to the less luxurious manufacturers of Yorkshire. It has been generally supposed that the manufacturers of woollens in the West Riding, have been greatly hurt by the war, and especially last year, by the impolitic measures of the American States, which were infinitely more injurious to themselves than they could possibly be to us; but it appears, that the manufacture of broad and narrow cloths (the only branch of the trade of which a precise knowledge can be obtained), last year amounted to 5,309,007 yards of narrow, and 9,050,970 yards of broad, very little less than an average of the ten preceding years, which include several years of the greatest export. And it should be observed, that notwithstanding all the declamation we have heard on the ruin of our trade, the decline in the exports of woollens of all sorts in the last year, compared with the preceding year, is only £519,282. official value.

The scanty supply of Spanish wool must very considerably raise the intrinsic value of our fine wools, which it is well known are very greatly improved within a few years; and the coat which I now wear shews that South Down wool may be used as a very good substitute for Spanish: its appearance is equally good. I have corresponded with every part of England, where there are considerable fairs for wool. At Hereford fair, 1st of July, Ryeland wool sold at 3*s.* 4½*d.* per lb. and was supposed to be undersold; my correspondent observing that his wool had been valued at 6*s.* 6*d.* per lb. by a man in the trade; but it should be remarked, that the Herefordshire wools are trinded, and cleansed from some of their impurities. It is added, that the sellers, pleased with prices higher than usual, had sold under the real value. Mr. George Wilbraham has this year sold his Delamere Forest wool for 3*s.* 4*d.* per lb. Some had been sold as high as 3*s.* 6*d.*, and one instance of 3*s.* 6½*d.* per lb. There are parts in the Delamere Forest fleeces finer than in the South Down; but the latter are more even, so that little difference is made in the price. Mr. Coke of Norfolk, who is well known to you all, as the distinguished friend of the agriculture and trade of the country, in his account of Thetford fair, 15th of July, says that there was a great attendance of growers, but little or no

business was done; that 2*s.* 8*d.* was generally offered for the Down wool; that some was sold at 2*s.* 10½*d.* per lb.; and that there was no doubt that 3*s.* will be generally given for the best. I have since learned that a considerable quantity of South Down was afterwards sold at that price. Letters from Suffolk mention that less than 80*s.* per tod of 28*lbs.*, which is about 2*s.* 10¼*d.* per lb., for South Down wool has been refused. Mr. Western of Essex, who is also known to many of you, as perfectly well-informed, says, that no business was done at the Colchester fair, 17th July; that one lot of a middling quality has been sold for 2*s.* 6*d.*, but that the growers of the best wools will not take less than 2*s.* 10¼*d.* per lb. Mr. Western sold his wool last year in Ireland at 3*s.* and his lambs' wool at 1*s.* 9*d.*: his factor says it will sell for 3*s.* 6*d.* this year. Even the common wool in the Weald of Sussex is sold from 2*s.* 6*d.* to 2*s.* 9*d.*; and Mr. Collins of Brenchley, Kent, has refused 2*s.* 3*d.* for his wool, a mixture of Romney Marsh and South Down; and I know several instances in this county and out of it where 3*s.* for South Down have been refused. I have not so detailed an account of Mr. Tollet's wool as usual; but I learn from him that he has sold to the same persons who have bought his wool for several years, 843 fleeces, of which 120 were pure Merino, for £878. 10*s.* which is 20*s.* 8*d.* per fleece. Notwithstanding the decline in the price of Spanish wool, the best quality has been sold within a short time at 15*s.*; but I understand that the manufacturers in the west of England have good Spanish wool at from 8*s.* to 10*s.* per lb. I have exerted the fullest inquiry to obtain a correct opinion of the value of wool this year, and after a due examination of a very extensive correspondence, the opinion I collect from it is, that 3*s.* appear to be a fair price for our finest wools, and so proportionably for wools of inferior quality; and I think it sufficient, because it is fully equal to 4*s.* when washed and brought to the state of Spanish. We should not appreciate our wool by the very contracted extent of the supply this year; but rather restrict ourselves to its intrinsic value. That value, I do not hesitate to say, the grower of fine wool has scarcely ever yet obtained. Hitherto it has been a depreciated commodity, it has seldom found an open market, and the wool-staplers have never evinced a proper degree of discrimination in respect to quality. But an advanced price has promoted, and will always secure a greater degree of care and attention to the quality of the fleece, rather than to the quantity, and unless we obtain a better price than heretofore, the weight of the fleece will be the principal object of the grower. This is a crisis in the wool trade

of Britain, and by not exacting exorbitant prices, the manufacturers will be induced to use British fine wools in the place of Spanish. *If the present extravagant price of Spanish wool should induce the manufacturers to encourage by advanced prices, the growth and manufacture of British fine wools, the prejudices of the country in favour of Spanish would be soon done away; and we should become independent of other countries for the materials of staple manufacture, and save nearly three millions sterling to this nation;—for nothing is more clearly demonstrated than that wool may be raised in England, equal in quality to any that is imported!*"

Expectation being very high in respect to price, Lord Sheffield mentioned 3*s.* which he knew had been refused by several, as a maximum for the finest wool. And he knew that price had been given in several parts of England for inferior wool; and that he by no means meant to guide the opinion in respect to wool of an inferior quality. It has seldom happened that much business has been done on the day of the fair, the owners of the finest wools insisted on £5. per tod of 32lbs. or 3*s.* 1½*d.* per lb. and there was little doubt of their obtaining at least 3*s.* per lb. A considerable quantity of the inferior wools was sold at 2*s.* 6*d.*

Lord Sheffield stated that his tailor, who was also his woollen-draper, and whose interest was not to over-rate the quality, had valued the cloth of the coat he then wore as worth 28*s.* per yard. The manufacture of the cloth, even at the present high prices, amounted to per yard

	£	s.	d.
high prices, amounted to per yard - -	£.0	6	1½
The wool at 3*s.* per lb. in the fleece -	0	7	0
	£.0	13	1½
Dying of drab at 3½*d.* per lb. - -	0	1	1¾
A yard of drab cloth - - - -	0	14	3½
If woaded to dark blue, at 2*s.* per lb. -	0	2	9
Manufacturing and wool - - -	0	13	1½
A yard of blue cloth - -	£.0	15	10½

Leaving, at 28*s.* or even 24*s.* per yard, a very sufficient profit to the manufacturers, draper, &c.

Report, July 27, 1810.

MY desire to acquire information that might be useful at these meetings has been encouraged by the flattering opinion which has been expressed, that my endeavours have been serviceable, and induces me to persevere in the inquiry into the state of the woollen trade, the probable supply and quality of wool from this and other countries, and the probable demand there is likely to be for our manufacture. The perpetually changing condition of the civilized world, its distracted and ruinous state seems to baffle inquiry, and to render it extremely difficult to offer you any satisfactory opinions; but, if we rely on facts, and it is to them I shall principally endeavour to point your attention, reasonable conclusions may be drawn.

The increased difficulty of procuring, and the consequent high price of, Spanish wool, raised the value of British fine wool, and induced our spirited farmers to attend to the amelioration of an article which had been greatly debased and neglected, in consequence of the pernicious monopoly at home, and the permission to import wool free of all duties from every part of the world. Depreciation and neglect of course raised a prejudice against the use of it in our finer manufactures, and it was no longer worth the while of our wool growers to attend to the quality, but to aim at the greatest weight or quantity. The adequate price now given for British fine wool has had a surprising effect, and the wool of our principal South Down flocks is infinitely better than it was a few years ago:—so much so that, with the help of the Spanish breed of sheep so rapidly increasing in the *United Kingdom, and for which we are particularly indebted to His Majesty, there can be little doubt that this country may become independent of all others as to the supply of wool of all kinds.*

The export of superfine cloths, compared with inferior manufactures, is not considerable, and the great bulk of our woollen manufacture has been of British wool, especially for exportation. Those of Spanish wool are principally for home consumption, which, however, is the best market. Very good superfine cloth is made of South Down wool, and is very sufficient for the woollen manufactories of Yorkshire; and when its improved quality is better known there, it will surely come into greater demand than is the case at present, where the northern wools are generally used, and the consumption of Herefordshire and South Down wool is not very considerable. The woollen trade in the West Riding is at present very

good, and there was an increase last year of 1,417,833 yards over the preceding year; 15,777,805 yards were milled within the year. The demand for low and middle priced woollens has swept away all the stock on hand, at an advance of from 5 to $7\frac{1}{2}$ per cent. and of course the price of wool employed in those manufactures has advanced. Prime Spanish wool has been purchased last spring at 18*s.* and upwards per lb. to sell again; and in March last, the current price at Bristol, from whence our fine fabrics of wool in the west of England are supplied, sold at 15*s.* per lb. Late failures, arising from extravagant speculation, have had the effect of forcing into the market foreign wools, at prices which refer more to the difficulties of the times, than to the regular demand of the trade. It appears that in future we cannot depend on the usual importation, consequently that the price of foreign wool will continue high, and the value of British fine wools will increase in proportion to the deficiency of the importation of the former. It is computed that Buonaparte has caused many thousands of Spanish sheep to be driven into France, and it is known that a large quantity of Spanish wool is accumulated in that country; which, as it cannot come to us direct from thence, possibly some part finds its way through Germany, which has raised the importation from thence into the port of London alone for the last quarter, ending the 5th of July, to 357,608lbs.

Notwithstanding the check in the west, the lowest prices of Spanish wool of the first quality in Bristol and London, were, about the 18th of this month, Leonesa 12*s.* Segoviana 10*s.* 6*d.* and Soria 10*s.* per lb.; and at the same time prime Herefordshire was 5*s.* per lb., South Down of the first quality from 4*s.* to 4*s.* 6*d.* per lb.

At Hereford fair, the beginning of this month, fine wool sold at an advance from last year of 3*s.* per stone of 12lbs.: 4*s.* $9\frac{1}{4}$*d.* was refused for wool of the Ryeland and Spanish cross, and some of an inferior quality sold at 4*s.* $7\frac{1}{2}$*d.* Of the middling kind of wool a great deal remained unsold. Mr. Clive sold his wool, (which is pure Ryeland with a slight mixture of Merino,) at 4*s.* per lb. The prime Ryeland sold at 3*s.* 7*d.* inferior Ryeland at 2*s.* $8\frac{1}{2}$*d.* per lb.; but it is said the Ryeland breed is so generally mixed with the Leicester, to promote the increase of mutton, that the wool no longer retains its pre-eminence, and that the South Down being considerably improved in quality, (especially if trinded and made up in the same

manner) is worth more in fact than the Ryeland sold at Hereford or Ross fairs. Most of the Herefordshire wool is sold to Gloucestershire clothiers.

At Ross wool fair on the 20th inst. the best Ryeland trinded wool sold from 3*s*. 2*d*. to 3*s*. 10*d*. per lb. One of my correspondents expects 5*s*. 9*d*. per lb. for his wool, which is very fine; hardly any Merino Ryeland was offered, and coarse wools were very low.

There is no regular fair for wool in Cheshire, but I learn from Mr. George Wilbraham of Delamere Forest, who is well acquainted with the subject, that the prices of the fleeces of that Forest vary very much from 3*s*. 6*d*. to 4*s*. 3*d*. per lb. which is a rise of 4½*d*. per lb. since last year. He observes the Delamere Forest fleece is finer than the South Down, but not so even throughout, and that it works well with the Spanish;—a convincing proof of the fineness of the pile; as does also the South Down, of which a considerable quantity has of late been carded with the Spanish in mills made for the purpose. He sold his wool this year, consisting of 235 South Down, 78 Delamere, and 30 mixed Merino, at 4*s*. 2¼ per lb. and one of his neighbours sold Forest and South Down at 4*s*., and mixed Merino at 5*s*. 1½*d*. per lb.: all these wools are bought up for the Yorkshire manufactories. I understand Mr. Tollet has sold his wool of Spanish mixture at 6*s*. per lb. including, however, one sixth part or thereabouts of prime Merino.

Thetford fair was better attended than usual; many wool buyers came from Yorkshire, who admitted there was no stock of wool in the West Riding; but little business was done at the fair. The growers of best South Down, and fine English wools expect 3*s*. 6*d*. per lb. when the small farmers, who cannot wait for better prices, have disposed of their wool. Mr. Coke informs me he has sold 774 fleeces, half-bred South Down and Ryeland by a Merino ram, at 4*s*. 6*d*. per lb. It does not appear that much business was done at Colchester wool fair.

At Dorchester fair in Oxfordshire, the whole of the wool brought there was sold. The best South Down there sold at 2*s*. 5*d*. per lb.; but it is much inferior in quality to our prime wool. Common Berkshire wool sold better than last year.

At the wool sale at London Wall I understand much business was not done. The Duke of Bedford sold some lots of pure South Down at 3*s*. 1*d*. and other lots at 3*s*. 2*d*. per lb. Mr. Ellman refused 3*s*. 3*d*. per lb. for his wool.

Some time after the last fair held at this place twelve months ago, the price of

South Down wool rose very considerably, notwithstanding the vehement assertions, that the market was greatly overstocked, and that the wool staplers could not dispose of their stocks. The prime wool sold soon after the fair from 3*s.* 1½*d.* to 3*s.* 6*d.* and upwards. Mr. Price of Lyminge in Kent, sold his South Down wool at 3*s.* 6*d.* per lb. And it should be observed, that he has no Down—he has only artificial grasses and a few grass fields: he keeps above 300 ewes, and Mr. Honeywood sold his wool of the same kind at the like price. But the South Down wool in Ireland, sold there last Summer by auction, greatly surpassed any price we ever heard of in this country; it sold from 5*s.* 1*d.* to 8*s.* 6*d.* per lb.

Mr. Tollet of Staffordshire, who has for a considerable time, and very ably, promoted the growth of fine wool in England (by breeding Spanish sheep, and by crossing them with fine woolled English sheep), has sold his whole lot of wool this year at 6*s.* per lb. His flock consisted of 711, of which 140 were pure Merino, the rest deep crosses upon the Ryeland: 711 fleeces weighed 3128lbs. which at 6*s.* came to £1. 6*s.* 4½*d.* per fleece, taking the flock through.

The official value of woollen manufactures exported last year is £5,416,151. which is £562.152. more than the preceding year. The trade in general greatly exceeded that of former years, viz. the exports in 1808 were £34,554,267. and in 1809 they rose to £50,101,763. and the general commerce of the country never flourished to the degree it does at present.

Under all these circumstances, namely, the increase of the woollen manufacture in Yorkshire, the extraordinary increase of our foreign trade, and the failure or great decrease of a future supply from Spain; as the quantity produced there will be greatly diminished in consequence of its devastation by war, and the ruined state of its flocks; and that the reduction of the price of Spanish wool, owing to the late failures, and extraordinary importation, should not materially affect the price of South Down wool, which is the principal object of our consideration, and which appears to be 3*s.* 4½*d.* per lb. from an average of the prices of that article sold since the failures, and within the present month, in the several parts of the kingdom. I have avoided all consideration of coarse or long wools, not wishing to perplex the subject with any thing that did not belong to it; I have made little inquiry, but I understand the sale is very dull. The Spanish breed is rapidly spreading over the kingdom, and also the breed of British fine woolled sheep, which must diminish the

growth of coarse wool, and consequently the value of an article so necessary to many essential manufactures will rise.

If my opinion respecting the price of South Down wool is desired, I should (notwithstanding the average value within the present month throughout the kingdom was 3*s.* 4½*d.* per lb.) recommend under all the circumstances, and for the encouragement of the fair, and the dispatch of business, 3*s.* per lb. for such bargains as may be made this day; but I am satisfied that those to whom it may be convenient, and who wish to reserve their wool, will have a better price; and that in future, when the present stock of foreign wool is disposed of, that our farmers who have attended to the quality of their wool, will never fail to obtain a very good price for it.

Report, July 26th, 1811.

The continued extravagant conduct of the enemy, infinitely more hurtful to the countries under his protection than it is to us, has greatly deranged trade and intercourse among nations; yet the distress which has fallen on this country, did not arise merely from the efforts of the enemy; much has been done through precipitate and mischievous speculations, as well as by the dissemination of notions, tending to destroy confidence, and to prejudice the credit of the country; for, notwithstanding the asserted decay of the woollen trade, in consequence of the war, I trust I shall be able to prove that the export of woollens has increased, and that the consumption at home must also be greater than ever it has been. It will be necessary to remark at some length on the enormous importations for several years past of foreign wool, which, not without reason, has occasioned a great degreee of alarm among the wool-growers of the United Kingdom.

The total importation of foreign wool into England, in the year 1808 amounted to 2,353,725 lbs., being only one-fifth of the amount of the import in the preceding year. Most of it arrived before the close of the Spring; and the French having possessed themselves, about that time, of the principal ports of exportation in Spain, it early became evident that further supplies would not arrive. The staplers and wool-factors immediately began to speculate upon this expectation, which ultimately proved to be correct. The speculators, some of whom already held considerable stocks, part of the extraordinary import of 1807, purchased every bag as it was offered for sale. Previously to those speculations, Spanish wool sold at the fol-

lowing prices; *viz.* Leonesas, 6*s*. 9*d*.; Segovias, 6*s*. to 6*s*. 6*d*.; and Sorias, 5*s*. to 5*s*. 9*d*., at a credit of eight months; but the prices were rapidly enhanced, and during the first six months of 1809, Leonesas were sold at 25*s*.; Segovias, 21*s*.; and Sorias, 18*s*. per lb. It is said that the foreign wools had cost the merchant 10*s*. per lb., and that they were, for the most part, in the hands of a few men of large capitals. Very many, who had imprudently engaged in the speculation, were ruined; whereas, immense profits were made by those who had purchased at the low rates of 1808, and contrived to sell the whole of their stock at very high prices, and then retired from the market.—Since that memorable speculation, Spanish wools have gradually declined in price. The manufacturer having no disposition to buy a larger quantity than his immediate necessities required, which was less than usual, in consequence of a considerable suspension of the manufacture, during the latter part of 1809 and beginning of 1810; and the import of wool, in 1809, being 6,845,338 lbs., and in the early part of 1810, much greater than at any anterior correspondent period, Spanish wools were, at length, reduced to their former prices. The total quantity of foreign wool, imported in 1810, was 10,936,224, being above one half more than an average import at the end of the last century, and inferior only to the extraordinary import of 1807, when the Spaniards, under an apprehension of impending political convulsion, sent here all the wool they could collect, to preserve it from the hands of the French. This large importation in 1810, and the embarrassed circumstances of commercial men, produced a still further reduction in the prices, and in January and February last they were very low.—Speculation then recommenced. The purchases of prime qualities, in the months of May and June last, have been very great; chiefly of last year's import, the spring importation, usually the season when the entries are most numerous, not being very considerable. Leonesas have readily sold at 8*s*. to 8*s*. 6*d*. per lb.; but this advance in prime wools has not much affected the inferior sorts, of which, it is said, there is fully two years' consumption on hand; the price asked for Segovias is 6*s*. and for Sorias, 5*s*. per lb. and not much is sold even at those prices. As the prime fleeces, however, are now taken out of the market, and in the hands of those who will not sell at low prices, the manufacturers of superfine cloths may resort to the next or inferior qualities, which will probably raise their price.

Prime English sorted wool, previously to 1809, was generally estimated at half

the price of the finest Spanish wool; that is, when the latter was selling at 6*s.* 9*d.* per lb. the English wool was worth 3*s.* 4*d.*; but, in consequence of the late speculations, it sold at 6*s.* For some time after the great failures among the wool-staplers, comparatively little was sold; but considerable quantities have been disposed of lately, at prices, however, much reduced, and lower than they have been, during several years; prime South Down, in the fleece, at from 2*s.* to 2*s.* 3*d.* per lb. The principal growers of English wool, not having sold the growth of last year, there must be a large quantity on hand; there is very little, however, in the hands of the manufacturers, who seldom keep any large stock. Although many of the staplers of English wool are very wealthy, few of them, at present, have money unemployed; their capital is not at command; it is partly locked up in the estates of those who have suspended payment, or become bankrupts; consequently, they have not the means of increasing their stock, and the lack of money obliges many of them to sacrifice the stock they have. Nothing has tended more to cripple and distress this description of persons, as well as many others, than the general withdrawing of discounts by all banks, the result of the publication of the Bullion Committee's Report; and the gloom which has prevailed among commercial men, has induced them to purchase much more sparingly than formerly.

When the prices of wool had been so extravagantly enhanced by speculation, the manufacturer, as usual, laid on his fabrics double the amount of the rise in the cost of the material; and the speculations in wool were closely followed by speculations in cloths. Even 40*s.* and upwards per yard were demanded by the drapers for blue cloths, and for a considerable time they obtained for them 34*s.* to 36*s.* per yard. But the high prices of Spanish wool, and of the cloth, after a few months checked the manufacture; there was more economy in the use of it, and inferior cloths were worn. Superfine blue cloths have since been reduced to their former prices, *viz.* about 24*s.* per yard. At this time, the manufacturers in Wiltshire, Gloucestershire, Somersetshire, and their neighbourhoods, are in general employed, and as it is called, at fair work, on the finest Spanish wools. The consumption of superfine cloths made of that wool, has been almost entirely by British subjects, and no considerable quantity has ever been exported to foreign countries. Superfine woollens are actually scarce, in consequence of the late suspension of the manufacture; and there can be no doubt that this branch of the manufacture will resume its former flourishing state, while Spanish wool is at its present moderate

price. As to the state of the woollen trade in Yorkshire, I learn that the stock of unsold goods on hand was much greater than usual: that the best sorted English wool, which was lately sold at 5*s.* 5*d.* per lb. now sells at 3*s.* 4*d.* to 3*s.* 8*d.* All the lower sorts have fallen in that district, but as their advance was less, their fall has been comparatively not so great. The best Spanish wool, which was once, in that part of the country, at 15*s.* and upwards, is now at 7*s.*; but Spanish fleeces by no means form a principal part of the wools worked up in Yorkshire.

The official value of woollen manufactures exported last year, *viz.* £5,773,214. exceeds the value of the exports of the year 1809, by £350,000. and those of that year considerably exceeded the exports of the preceding year.—The average exports of the last forty years, which includes the most flourishing period of our trade, is £4,662,523. considerably more than £1,000,000. below the exports of last year; but these, it should be observed, are the official, not the real values. They, however, answer the purpose of comparison. The real value would probably amount to nearly double. I learn, also, there is no diminution of the exports of woollen manufacture in the first quarter of this year. The exports of cloth to America, in the early part of the present year, were very great, probably in anticipation of the American prohibitions being again enforced; but cautious dealers detained their goods, which were not ready in time to reach America, before the 2d of February, and have them on hand, whilst those who ventured to ship in our ports till the 1st of February, succeeded in having them received. The East and West India demands for woollens are the same as usual, but very little business is doing with Germany, Holland, and the North of Europe. It should be observed, that France at no time took a considerable part of our woollen exports.

The average importation of wool in 19 years ending 1715, was only 869,727lbs. and even at that time we considered woollens as our principal and most valuable manufacture. The average importation of eight years, ending 1789 (the commencement of the French revolution) was 2,660,828lbs. The average of eight years ending 1799 was 4,020,000lbs. and the average of eight years ending 1810 inclusive, was 7,729,929lbs. This immense increase since 1789, must of course greatly clash with the essential interests of the landed property of the United Kingdom; for although the prime foreign wools, *viz.* Leonesas, even at 6*s.* 9*d.* can hardly interfere with English fine wools at from 2*s.* to 3*s.*; yet, as a great proportion are the lower wools from Spain and Portugal, which, in consequence of the great

failures, have often sold of late for less than the freights and insurance, they not only interfere with the first crosses of the Merino with British ewes, but also, with the prime clothing wools of English breeds, such as the Hereford and South Down; and the knowledge of the very extraordinary quantity imported, and of the stock of wool in the hands of the growers, has so much prejudiced the sale, that the growers seem entirely at the mercy of the buyers, and the latter are not averse to take advantage of circumstances which tend to keep down the value of wool.

The patriotic endeavours of his Majesty, and of several spirited individuals, to establish a permanent and adequate source of supply of fine wools in the United Kingdom, by the introduction of Spanish sheep, have succeeded more fully, and the object now seems likely to be more rapidly attained, than even the most sanguine had expected. There is every reason to believe that the Merino wool of British growth, such as his Majesty, Mr. Tollet, and other gentlemen have raised, if it were washed and sorted in the Spanish mode, might go to market in successful competition with the average of the Leonesas or best Spanish wools. The progress already made in the culture of wool of the Spanish breed, in England, is very encouraging. The fineness, and consequent value, of the fleece, compensates the deficiency of value in the carcase; but, if adequate prices be obtained for the wool, the growers will persevere in their exertions to improve the form and weight of the sheep, and it is probable that they would ultimately succeed, without deteriorating the excellence of the fleeces. These laudable exertions, however, to relieve the country from a great annual expenditure, for supplies of the materials of its staple manufacture, will prove unavailing, if the wool of every part of the world is to continue to be admitted duty free. The wool grower will of course soon cease to endeavour to improve the quality of his fleeces, when he finds his labours unrewarded by an adequate price, and his attention will be turned from an improvement of the quality to an increase of the quantity; and thus we shall relapse into our former indifference of the character of our wool. The mischievous tendency of an unrestrained importation of foreign wools is now so glaringly obvious, that it must be regarded as an instance of national folly, if we do not immediately interpose some control upon the entry of inferior woods.

As it has been demonstrated that we can raise, in these islands, wools, as fine and as well adapted to our purposes, as those which we import, it is a highly unprincipled policy to continue to encourage an importation which costs us some

millions sterling yearly: and, at a time when we are necessarily so greedy of revenue, a duty of one shilling per pound on foreign wools, (which would have produced, last year, the sum of £546,550.), may be proposed as a very desirable measure, and would be supported by the best practical principles. While it would check the importation of wools of inferior quality, it would not, in any wise, prejudice the manufacture, or prevent the introduction of prime Spanish fleeces, such as we used to import. It might, perhaps, furnish a pretence to the manufacturer to increase the price of the finest cloths; but he could have no ground for complaint, as the sale of those prime fabrics, is almost wholly confined to the home market, where he is free from the competition of foreign manufactures, and would be amply indemnified, for any temporary advance of capital in payment of the duty, by the enhanced price which he could command for his commodity. But from the competition among speculators in foreign wool, and from the fluctuations in the market prices of that article being, as they must continue to be, during the present unsettled state of things, considerably greater than the amount of the proposed duty, it is probable that the manufacturer would be able to purchase the raw material as cheaply, as if it were not liable to the payment of the duty; and as only a small proportion of the fabrics manufactured from Spanish wool, goes to foreign markets, there can be no objection to the duty on the ground of injuring our export trade in woollens. It is a sufficient sacrifice of the landed to the manufacturing interest, to suffer the prohibition of the exportation of any kind of agricultural produce; but, the free admission of sheeps' wool of every quality, without subjecting it to the payment of any duties to countervail the comparative cheapness of the countries from whence it is brought, to the great discouragement of the growth of wool in these kingdoms, is a sacrifice of essential interests in favour of foreigners, which cannot be supported by any principles of justice or sound policy. There can be no more doubt of the good policy of imposing a duty on foreign wool, though a raw material, than there is of the necessity of a duty on corn (the raw material of bread), when the price is reduced so low as to discourage its culture. It is not long since that we imported the greater part of the iron used in our manufactures; and there seemed to be a perfect despondency in respect to our ability to procure a supply from our own mines. However, the perseverance and skill of our iron masters, aided by a duty of £3. 7*s.* progressively increased to £5. 9*s.* 4*d.* and £6. 13*s.* 4*d.* per ton, have brought the manufacture of iron in Great Britain

to such a high state of perfection, that in the course of 25 years, the quantity of foreign iron, imported for our use, has been reduced from 50,000 to about 16,000 tons, thereby saving to the country upwards of £800,000. yearly, notwithstanding a very considerable increase in the consumption of iron has taken place within the same period.

It has been speciously said that, by excluding the common wool of the continent, we should promote the manufacture of it abroad: but this argument is not entitled to any consideration; for, in fact, the proposed duty would merely affect the sale of those inferior wools which have found their way into our markets, only within the last four or five years, and not, by any means, the description of fine wools which alone were formerly imported: and if the foreign grower, when excluded from our markets, should find the manufactories suspended which used to consume his coarse wools, as is the case, he will of course convert his pastures to other objects of culture. The principal object of the proposed duty is to check the unusual introduction of inferior wools, and thereby to prevent the discouragement of the growth of our own country; and to enable our fine wools to sustain a competition with the fine wools of other countries until the growth shall be equal to the supply of our manufactures. It will not surely be disputed that we ought not to expend our money in bringing a raw material from a foreign country, when we can raise it, with advantage, at home. But, wherever taxation is carried to a great and increasing height, and ultimately equalizes itself by attaching to the consumers, as in this country, the prices of commodities must, for the most part, progressively increase; and hence, raw materials of manufacture, the produce of the soil, in countries not subject to the same degree of taxation, will be proportionably cheaper than in Great Britain. Unless, therefore, we prefer to abandon our agriculture altogether, and to trust to precarious supplies from abroad, we must impose from time to time such duties upon products similar to our own, imported from foreign countries, as shall place the native cultivator upon an equal footing with the foreigner; for, the consumer will purchase at the cheapest price, and no man will long employ a capital in the production of an article which cannot afterwards be disposed of at a reasonable rate of profit. The validity of these principles cannot be refuted; and with respect to the particular subject of our consideration, it must be generally acknowledged that, under all the circumstances of the case, this is not only a proper moment, but the best, probably, which will occur, for carrying into

execution a measure, the necessity for which is so clearly demonstrated by facts, and which comes recommended to us by the soundest principles of national policy.

But, to return to the causes of the dullness of the wool market; it may be imputed, not only to the overstock of foreign wool, but to the general distrust so diligently promoted; to mischievous speculations, and the difficulty in procuring discounts: these have produced many bankruptcies. The scarcity of gold is most erroneously attributed to particular operations of the enemy, to the war, and sometimes to the conduct, highly infatuated, of the American States; but it may in great measure be imputed to our own bad policy, the neglect of encouraging tillage, the suffering it to labour under great depressions, permitting the grain of countries comparatively untaxed and untythed, to enter our ports, when the price of grain is too low to pay the farmer his expenses; the allowing millions of acres to lie waste, and, instead of assisting the improvements by premiums and bounties, permitting the money which might be most advantageously employed in the cultivation, to be swallowed up by lawyers, agents, and the clerks of both houses of Parliament, in soliciting and procuring separate acts of inclosure. Much waste land remains uninclosed and will remain so, solely on account of the great expense which must be incurred in obtaining inclosure acts. Very many parcels of common or waste land, though good in quality, being less in quantity than 7 or 800 acres, will not pay the present extravagant expense of a separate inclosure act: therefore, those parcels must ever remain comparatively in a state of waste, to the great disgrace of the national policy. These separate causes prevent the growth of a sufficiency of grain; and they preclude us from maintaining our former export trade in that article, which sixty years ago was very great. It was the deficiency of grain in 1796, through the want of due encouragement of agriculture and of the cultivation of waste lands, far more than foreign subsidies, that drew from this country its gold, and brought on the Bank restriction in 1797; and from that time we have annually imported grain, on an average, to the amount of £7,000,000.; which added to the large sums we have paid for foreign wool, accounts for upwards of ten millions sterling unnecessarily sent yearly out of this country. In the years 1800 and 1801, the value of grain imported amounted to the immense sum of nineteen millions sterling. Besides, we have, perhaps, too largely run into the measure of importing various articles of foreign produced merchandize in much

greater quantities than our home consumption required, or we can find a vent for, by re-exportation. The whole of them, indeed, may not be imported on British account; but the advantages of the warehousing system, by which the payment of duties is suspended until the goods are taken out for home consumption, and none levied when re-exported, have rendered our principal ports the entrepot of the commerce of great part of the world; and the profits of commission, &c. tempt individuals to make considerable advances of money to the owners, even long before they are enabled to dispose of the goods; whereby the demand for bullion and specie to send abroad has been encreased, and bills of exchange on this country multiplied. These and the necessary supplies of our army and fleet, sufficiently account for the unfavourable state of exchange. The restoration of confidence is principally necessary to maintain a reasonable degree of commerce. But we may despond of that blessing, while we are liable to such mischievous suggestions,—as that the rental of England, and its commerce and manufactures, are dependent on, and must vary with, the price of bullion on the continent, and other foreign circumstances, a doctrine which can only tend to distress his Majesty's government, and through it occasion great confusion and mischief to the country. Too many of us are apt to be misled by insinuations, though superficial, and scarcely plausible. It is a false notion that this country till lately depended on the precious metals for its circulating medium. Our trade would have been much more limited, if we had not brought in aid a great paper currency; and if our coin had not found its way to the continent, I do not know how we should have been able to pay for the immense quantities of grain, wool, and other articles we have imported, and also the freight, or how we could have supplied our armies abroad. The rate of exchange is not affected by the issue of Bank of England paper; and I have little hesitation in saying that, the depreciation of that paper will not be felt as long as the immense revenue of this country is received in Bank of England paper at the Exchequer. The deeming it a legal tender seemed to be the natural consequence of the restriction of cash payments.

I fear some of these details will appear superfluous, but they are necessary to justify and explain some general conclusions that I draw from them, and which I shall now briefly state:

That the scarcity of gold is not to be attributed, merely to the war, to the particular conduct of the enemy, nor to the hostile and unfriendly conduct of the

American States; but, in a great degree, to bad policy in our interior management.

That large quantities of gold coin are not necessary to commerce: as has been amply proved in the instances of Holland and Scotland, which countries had but a very small quantity of coin in their most flourishing state.

That the demand for woollens for the home market is not diminished, but probably much increased, and that the export of them is also much increased.

That comparatively with the whole amount of the manufacture, the demand for foreign countries with which we are now at war, was not considerable.

That speculations in foreign wools, and the extravagant variations of price, have deranged the trade and manufacture of that article: but those wools being now reduced to their former price, and the manufacture of them being principally for the home market, there is little doubt of its being restored to its former state.

That there is no great quantity of prime Spanish wool in the market; but that there are very large stocks of inferior foreign wools, and that a large proportion of last year's clip of English fine wool is still on hand.

That it is not the decay of the manufacture or the want of demand for it, but difficulties respecting money, and the great stock of wool in hand, that occasion the debasement in price.

That the staplers of English fine wools have greatly suffered by speculations, by distrust arising from erroneous notions, and by the difficulties of obtaining discounts.

That the sale of fine English wools is greatly prejudiced by an immense importation of foreign wools, particularly of inferior sorts, and by the distressed state of the staplers.

The want of opportunity for inquiry and information often renders us liable to admit fallacious opinions and suggestions. If the positions I have stated for your consideration, should assist you in the investigation of subjects so very interesting to the country, it will afford me great satisfaction. My wish is, that we may not be led away by incorrect notions of the causes of the difficulties that have occurred. If we see distinctly how they arise, it will prove less difficult to obviate them.

I now come to the most disagreeable part of my report; the statement of the low prices lately given for fine English wools.

Hereford fair, the first of this month, was very ill attended, and the several sorts of wool were sold at prices very considerably reduced; the finest wools sold from

2*s.* 3*d.* to 2*s.* 4¼*d.* which is nearly one-third less than the price of last year, but very little was sold. There was no demand for the inferior wools; sufficient business was not done to note the price, but every thing sold very ill at that fair.

At Ross fair, on the 20th instant, as in most other places, little has been done; the best Ryeland sold from 2*s.* 4*d*½. to 2*s.* 6¼*d.*; 3*s.* was refused for Anglo-Merino wool, which sold last year at 5*s.*; and at Coleford fair, remarkable for fine wool, the prices were greatly reduced from those of the preceding year, and some was sold as low as 2*s.* 1*d.* per lb. It is the opinion, however, that wool will rise, as in Gloucester, and other parts, there is very little fine wool on hand, and at present, a great demand for fine cloths.

Shropshire wools are selling from 1*s.* 6*d.* to 2*s.* in the fleece; these are not much more than half the prices they sold for during the speculation.

In the neighbourhood of Bristol, in the beginning of this month, South Down sold from 2*s.* to 2*s.* 3*d.* Dorset, Devon, &c. 1*s.* to 1*s.* 6*d.* long wool 9*d.* and little was disposed of. These very low and discouraging prices, of course, prevented the owners of the wool from selling; but Spanish wools are the great article for sale in that district, and its price has already been stated; some English-Merino wool washed, sold in Bristol at the very low price of 4*s.*

At Dorchester fair in Oxfordshire, South Down wool, certainly of an indifferent quality, sold for 1*s.* 6*d.* per lb. the same as sold last year for 2*s.* 5*d.* The wools of Wilts. and Berks. from 1*s.* to 1*s.* 1*d.*; one lot of coarse Leicester and Gloucester cross at 11¾*d.*; and some Spanish lambs' wool for 4*s.* Almost the whole of the wool offered for sale, notwithstanding the depreciation in price, was sold. The farmers being aware of the utility of the fair, are determined to support it.

In Suffolk only 1*s.* 6*d.* per lb. is talked of for Norfolk and South Down wools; but it is only little farmers who have sold any. The great farmers consider the price so unsettled, and the demand so trifling, that they do not sell at all.

In parts of Staffordshire where wool is grown, about the quality of untrinded Herefordshire, and fully as good as the South Down, some has been sold at 2*s.* to 2*s.* 1*d.* about a third less than last year.

The great sale for wool in Ireland was not to take place till the 23d, of which we could not yet have any account; but it was expected there would be a ready demand, and good prices, at least for the best lots. The prices of the common cloathing wools, of an inferior quality, have been from 1*s.* 7*d.* to 1*s.* 9*d.* per lb.; and

from 2*s.* 6*d.* to 2*s.* 8*d.* for wools of the first cross between Wicklow and South Down: so much has the native breed improved by crossing with South Down rams.

I have confined myself principally to the fine clothing wools, but as to the low priced English wools, I understand they have been bought up in many parts of the country as freely as usual.

With a view to obtain the best information in my power, I have engaged in a very extensive correspondence, and I have collected a great number of the best documents that could be acquired; I have not made use of any information but that on which I was satisfied I might depend, and the authorities are highly respectable: the details have been examined with great care; and I have made a selection of what appeared consistent, and what I conceived might be useful both to the buyer and the seller. The information shews that so little business has been done, that no fixed price can be stated. In many parts, the dealers had not come into the country, as usual; but the price is rising, and considerably; and it is a general opinion, that it must and will speedily rise higher, and that credit is in a considerable degree re-established. There is an expectation that some ports, which are now shut, will be open to us, and that when the check which has taken place in consequence of the late derangement is at an end, English wool will readily sell at its former prices. It is known that until very lately, no wool was sold except by the necessitous; that the wool staplers have supplied the manufacturers from their old stores, which must now be much exhausted; that the manufacturer draws his supplies monthly, and sometimes weekly, and seldom has any large stock in hand; and that the staplers have, at present, but little money at command.* Under these circumstances, the growers of fine wools, in all the principal districts, have no expectation of a sale at present, the price being so inadequate to its intrinsic value; and they seem to have concluded on keeping it, until a more regular demand shall arise. The fair at Dorchester in Oxfordshire, where inferior wools were sold, is the only exception that has come to my knowledge.

It is the opinion of some, that there is no more wool now in the hands of the growers than there used to be in those of the staplers; but I conceive it probable, that the late good prices for fine wools, may have increased the growth of them

* The wool growers usually contract with the staplers for prompt payment; the proceeds of their wool being generally applied to the payment of their rents at Michaelmas, especially those who are not very opulent.

considerably. If the legislature, however, should not give the country that protection to which it is entitled, by adequate duties on the import of foreign wools, it is certain that such immense importations must utterly put an end to the growth of fine wools in the United Kingdom.

As to the price that should be accepted for our wool, it is very difficult to give an opinion. I have stated all the facts that appeared to me worth the attention of the meeting, and notwithstanding the home consumption and the exports are both increased, perhaps in consideration of the embarrassed state of the money market, and the redundancy of foreign wools, it may be advisable to take from 2*s.* to 2*s.* 4*d.* per lb. for the best South Down; and this reduction I am sure is full as much as the times require.

The meeting appeared very much satisfied with the Report. Lord Chichester proposed the health of Lord Sheffield, and the thanks of the company, for the useful information he had given, and the comprehensive view he had taken of the subject; observing that without the advantage of the information, Lord S. had yearly communicated to the meeting, they would have been under great difficulty to form a conjecture of the real value of their wool, and of the state of the trade. The wool buyers acknowledged the fairness and correctness of the statement; they said they had suffered so much, that the trade could not afford even the reduced prices proposed by his Lordship; and they alluded to the non-importation law of the American States.—Lord Sheffield insisted that the home consumption and the export trade being both increased, there was no ground for a reduction of the price given of late years for the South Down wool, except that of the market being overstocked with foreign wools: that the reduction he proposed was from 10*d.* to 1*s.* per lb. nearly a third; and that previously to the late speculation, the best had sold at 3*s.* $3\frac{1}{2}$*d.* per lb.; that the manufacture had been raised upwards of a third per yard, but that the average between the low and the high prices did not justify a rise of more than 1*s.* 8*d.* per yard. He was satisfied, if the American States should, through a partiality to France, or the wrong-headedness of a party there unfavourable to Great Britain, again enact a Non-Intercourse Law, it would be evaded, or not generally observed. The people of that country will not go naked, from affection to the French, or enmity to this country; and whatever they can pay for will find its way to them, and what they do not take from us this, they will another year; and thus, it has always been found they have taken on an average nearly the

same quantity. It does not appear that they can get clothing from any other country at present, nor will it be possible for them, for a long time, to manufacture sufficiently for themselves; and this is most certain, that they cannot dispose of their produce or merchandize but through this country, and that the United Kingdom can get every article of the produce of the American States, fully as good and as cheap from other countries. Lord Sheffield added, that all events, it would be adviseable to keep the wool, if they could not get 2*s*. 3*d*. for the best lots.

A very considerable quantity had been sold before the fair at 2*s*., and for some lots 2*s*. 3*d*. has been given.

The same backwardness to purchase which took place at Lewes, prevailed at the other wool fairs.

The Thetford fair was numerously attended; little business was done in the room, but there was an evident desire in the buyers to purchase privately, the best wool at from 20*d*. to 25*d*. Some were sold at those prices, but a rise was expected, and the farmers shewed little disposition to sell at these low rates.

At Ashford fair in Kent, (not long established) there was nothing done in South Down or fine English wools. The demand increasing and value rising considerably.

At Colchester only 21*d*. per lb. was offered for the best samples of Norfolk and South Down wools, and pretty good wools sold at 19*d*. The wool growers seem disposed to take nearly one-third less of the prices of late years, but the wool buyer, very unreasonably requires a greater reduction.

The demand for woollen manufactures has lately been considerable; they find their way to Russia, and large assortments are in hand for the spring shipments to America. It would also appear that, the superfine clothing trade is particularly brisk; in Gloucestershire, the manufacturers are very actively employed, and several establishments are mentioned as now breaking 20 packs of wool a week, each. It may, however, be remarked, that the prejudices of the manufacturer are such, that he is now daily buying inferior Spanish wools, by no means equal to fine English wools, at very superior prices to what he will give for the English.

Principal persons concerned in the import of foreign wools, say, that notwithstanding the importation in the half year ending 5th July last, has been 3,140,676lbs. scarcely a bag has been received which would, three years ago, have been esteemed

of prime quality; and but comparatively a small quantity of superior seconds.—Nevertheless, foreign wools, as above observed, when compared with British fine wools, obtain high prices; though they do not yield more than a fair average profit to the importers.

A gentleman who has just returned from Spain, whither he went last Autumn, for the purpose of inspecting the flocks, and contracting for fine fleeces, says, that if the country were immediately relieved from the destructive warfare in which it is at present plunged, many years must elapse before the flocks would recover their former state of perfection. There is now scarcely a pure flock in the country, and from the impossibility of obtaining the usual succession of pasture, and other causes, the fleeces are generally very much deteriorated in quality. He accounts for the importation of wools this year, by the fact that it has been composed chiefly of the inferior wools which Spain was accustomed to retain for the consumption of her own manufacture, very few of which have been able to continue at work. It is acknowledged, that formerly the greater part of these wools would not have found a market here.

The current prices of Spanish wools have risen considerably within the last three weeks, but on comparing these prices with what have been obtained in the course of the last three or four years, reference should always be had to the circumstances above stated, as at least 25 per cent. should be added to them.—Thus for instance, a parcel having the prime Leonesa marks was sold last week at 8*s.* 3*d.* but the fleeces were very foul, and when brought into the state in which wools of the same marks used to come, they will have cost the purchaser about 11*s.* 6*d.* or 12*s.* and even then they will not be equal in quality, on account of the commixture of fleeces. Very large quantities of Sorias have, in like manner, been sold as low as at 2*s.* 3*d.* and 3*s.* per lb.

The sheeps' wool imported into Great Britain, on an average of four years ending 5th January, 1811, was 7,865,567lbs.; and the quantity imported in the half year ending 5th July, 1811, distinguishing the countries whence imported, was as follows:—

	lbs.
Germany and North of Europe	41,594
Portugal	872,681
Spain and Gibraltar	2,147,696
Malta and Levant	49,654
Ireland and Isle of Man	3,690
Cape of Good Hope	4,318
States of America	7,103
Brazils	12,741
Prize	1,193
Total lbs.	3,140,679

of which 1,727,000lbs. were imported in the first quarter of the year, ending 5th April last. It is difficult to ascertain what proportion of these wools came from France; but it is known that a considerable quantity was brought here, in neutral vessels, indirectly from that country.

The quantity of wool disposed of by auction, at the annual sale in Ireland, on the 24th and 25th of July last, exceeded the sale of the preceding year by 1305 fleeces, and has increased since the first institution in 1806 from 100 to 5249 fleeces.—The late speculations and derangements in trade do not seem to have affected the wool trade in Ireland, nor has it suffered by the combinations of the jobbers.

	per lb.	
Lord Clermont's 171 fleeces of South Down sold at amounting to 15*s*. per fleece.	6*s*.	8*d*.
Mr. Crichley's sold at	6	7
Mr. Owen Wynne's 329 fleeces, average 16*s*. 3*d*. per fleece, at	5	9
Sir John Sebright's at	3	8
His fleece, weight 5lbs. amounted to	18	4

The average price of the whole of the South Down wool there sold was 3*s*. 4*d*. per lb.

Dr. Butler's 91 fleeces of Merino sold at 12*s*. 3*d*. per lb. Several other lots of Merino sold at 7*s*. 8*s*. 9*s*. and 10*s*. per lb. Mr. George Evan sold seven Merino fleeces for £15., viz. at 7*s*. 6*d*. per lb.

Lord Meath's South Down on Wicklow sold at 4*s*.

The farming Society of Ireland report, that the introduction of the Merino breed into that country has exceeded the most sanguine expectations of the manufacturers, and promised amply to repay the expense of the import of Spanish sheep; the avidity of the buyers to purchase the wool, must account for prices evidently beyond the intrinsic value of unscoured wool. The parcel that sold highest was shorn from a portion of the flock imported into Cork last summer, and was considered equal to any that Spain could produce. The manufacturers were perfectly satisfied with the manner in which it was made up, though merely river washed upon the sheep's back. In every instance where the soap washing had been used, the appearance of the wool was injured, and it was the general opinion that washing carefully upon the sheep's back in pure river water, was the safest and best method to adopt.

The extraordinary advantages resulting from the cross of Merino on South Down, appeared not only in the parcels of wool of that description, but by the high prices at which they sold; exceeding the rate of pure Merino in many instances.

The Farming Society pay a just tribute to the spirited exertions of Dr. Parry, who presented the Society with a ram from which, on the South Down ewes of Mr. Grierson, the wool of some sheep of one year old attained the extraordinary price of 9*s.* 9*d.* per lb. unscoured.

The Report further says, that the South Down wool and the crosses of the South Down on Wicklow Mountain sheep, did not bring the extravagant prices of the last year, but sold in general very well, and would have sold much better, but for the inferiority of many parcels, from having been badly made up, and from the want of judicious selection by some of the breeders.

At Rathdrum shew of cattle in Ireland, the 5th of this month, Mr. Owen Byrne obtained the first premium for ewe lambs of the cross of South Down on Native Wicklow Mountain, and his wool was much approved and bore a high price, being the first cross of South Down, the progeny of which are found to possess all the hardiness of the native breed; but the Merino wools were the favourites, and the general opinion was, that a cross from the Merino and South Down, if generally established, would be productive of a superior growth of fine wool.

Ignorance and prejudice, however, here in England keep down the price of British grown Spanish wool; yet the spirited introducers of the Spanish breed

should not be discouraged. The produce of Lord Castlereagh's Merino flock this year, averaged 5 lb. 5 oz. per fleece of wool washed on the sheep's back. Some of the ewe tegs clipt 7 lb. 8 oz., it is deemed worth 8*s.* per lb. at which price the fleeces, on an average of the flock, are worth 43*s.* each. A very considerably smaller profit would compensate for a deficiency of weight in the carcase. The intelligence of our breeders will soon, by crossing, bring the sheep to such form, as we deem more perfect; and it seems proved that the wool of the Spanish, crossed on Ryeland and South Down, is fully equal to the whole breed of Spain. If the constitution of the sheep that first arrived from that country, does not completely resist our climate, their descendants bred in England will acquire sufficient hardiness, and even by degrees be brought to bear the fold, if it should be required, as well as our own sheep; and the closeness of the wool and the crust of a waxy matter which peculiarly belongs to the breed, ought to preserve them better from the inclemency of the weather, than the slighter fleeces of the English fine woolled sheep. The foot-rot, to which the Spanish sheep seem liable, might be avoided by attention and care.

Report, July 27th, 1812.

Since I last had the honour of attending this Meeting, the value of English fine wools has been too low to encourage the growers to prefer quality to quantity. I have, however, the satisfaction of observing that for some time it has been gradually on the rise. The depression has been most erroneously imputed to other causes, but the real cause was the immense importation of wool from the Continent, in a much worse state, and inferior in quality, to that which used to be imported. In consequence of the quantity being more than was wanted for consumption, or for which there was a demand, it sold at low prices; and, through the prejudices of the manufacturers, greatly interfered with English fine wools.

The average importation of foreign wool, in the beginning of the last century, was only 869,727 lbs. The average of eight years, ending 1789, was 2,660,828 lbs. The average of eight years, ending 1799, was 4,020,000 lbs. The average of eight years, ending 1810 inclusive, was 7,729,929 lbs.

Wool imported in the year—

1806	-	-	-	7,333,993 lbs.
1807	-	-	-	11,768,926
1808	-	-	-	2,353,725
1809	-	-	-	6,845,933
1810	-	-	-	10,936,224
1811	-	-	-	4,739,972

The two quarters ending 5th July, 1812, 2,587,533 lbs.

The importation of the first quarter of this year, ending the 5th of April, into Great Britain, was 816,608 lbs. of which 593,187 lbs. came from Portugal, while only 190,125 lbs. were received from Spain. But in the quarter ending 5th July, 1812, the importation of foreign wool into London was 1,383,215 lbs.; rather more than the greatest importation in former years, during that quarter. The importation into Bristol for the same period was 230,910 lbs. and that into Liverpool amounted to 156,800 lbs. Total of the two quarters, ending the 5th of July, 1812, 2,587,533 lbs. which is about a sixth less than the importation during the same period the preceding year. A greater decrease in the importation might have been expected in consequence of the ruinous state of Spain and of her flocks, and also in consequence of the greater part of the country being then in possession of the French. I am informed also that very little wool remains in those shipping ports of Spain and Portugal which are now open to us. The quantity of Spanish wool in this country must be considerably decreased, as in April last the demand for broad cloths, in every part of Gloucestershire, Somersetshire, and Wiltshire, was greater than has been known; and it is supposed the present consumption exceeds the importation. Every hand is now employed, and many of them both day and night. Many of the great manufacturers work up from thirty to forty bags, and upwards, of Spanish wool, per week, and could employ double their present number of hands if they could be procured.

Since the Bristol fair, last September, Spanish wools advanced from 1*s.* 6*d.* to 3*s.* per lb. There has been some decline in the price, but at Bristol, July 16, 1812, the prices were—

Prime Leonesas from	-	-	9*s.* 0*d.* to 9*s.* 6*d.*
Prime Segovias	-	-	7*s.* 6*d.* to 8*s.* 6*d.*
Prime Sorias -	-	-	6*s.* 6*d.* to 7*s.* 6*d.*

The increase of price and of consumption, and the decrease of importation, must necessarily raise the value of fine English wool: but the above are the prices of the prime sorts. It is the unlimited importation of inferior wools that will discourage the growth, and will ultimately prove ruinous to English fine wools, if not protected by an import duty. The growth of wool in England actually exceeds the demand, and is more than is likely to be wanted in any state of our trade, at least so as to give a satisfactory return or a reasonable price to the grower. Wool is the only article which is prohibited from seeking another market in the case of a redundancy, and nothing can be more unjust, nor calls more loudly for redress, than the unprincipled measure of suffering an article to come from every part of the world, free of all duty, in competition with the wool of this country, so taxed and tythed. Our Wool labours even under what is worse than a maximum, and is entirely at the mercy of those whose interest it is to debase the price. Every principle of policy and of justice, requires that an import duty should be laid on foreign wool, by which our revenue would be considerably benefited, and the growth of fine wool, which has with so much spirit been lately promoted in the United Kingdom, would be permanently established. It may be necessary that every county should address the Legislature, and if relief cannot be obtained, we must diminish our flocks or relinquish the growth of fine wool.

In respect to the demand for our woollen manufactures, on which the value of wool must necessarily depend, there is no ground for apprehension. The home market is greatly increased, and on that we may rely; and I flatter myself I shall be able to show, that it is comparatively not a very considerable proportion of our manufactures that goes to foreign countries. But so much has been said in respect to the decline of trade, and of the consequent reduced demand for wool and woollens, that it is necessary to enter into some details to expose the fallacy of those suggestions.

First, as to our general trade. The real value of exports from Great Britain to all parts of the world, average of three years, ending 1807, inclusive, was £51,540,224

Average of four years, ending 1811, inclusive - - - £55,657,372

So that our general exports have increased upwards of £4,000,000. on an average, above the years preceding the operation of the British Orders in Council and American Non-importation and Embargo Laws, to which the supposed declining trade has been so clamorously and so falsely imputed. The trade to certain countries has declined by the change of its direction. The Act for the Abolition

of the Slave Trade,* the American Non-importation Act, the Berlin Decree, and the Orders in Council, which blockaded the coast from the Elbe to Brest, both inclusive, took place in 1806; and in the following year, the best measure of Lord Grenville's administration, the retaliatory Order in Council, dated the 7th of January (from whence sprang the other Orders), the Milan Decree, the American Embargo, and the war with Russia; all these took place in the year 1807, and necessarily produced great variation in our trade. The exports in 1805 and 1806, which were very great, on an average of the two years £52,069,006; on an average of the two following years, viz. 1807 and 1808, declined £1,842,803. But on an average of the two following years 1809 and 1810, they amounted to £64,360,060, amply making up for the decline of the two preceding years, and also of the subsequent year 1811, when the exports fell to £43,939,620, a very natural decrease arising from the excess of preceding exports. Thus, notwithstanding all the impediments and adverse efforts of the enemy, the commerce of the British Empire, on averages compared with any former period, has not suffered, but has considerably increased.

The powers of production in the British Empire are at present so great and so extensive, that demand can scarcely keep pace with them. Our commerce in 1809 and 1810 was greater than ever it had been; and it is not surprising that, after extraordinary production and exportation, foreign markets should be glutted, and that the subsequent year (1811) should fall short, in some proportion, to the extraordinary excess of the two preceding years.

So far relates to the general trade of the country; but the great complaint has been the failure of the exportation of British manufactures to the American States. Perhaps the public has never been more completely imposed on, nor a greater proportion of it more completely duped, than it has been by the ill-founded clamour so diligently and mischievously fomented against the Orders in Council.

The real value of the exports from Great Britain to the American States, previously to the American Non-importation and Embargo Laws, and to the British Orders in Council,—average of three years, ending 1807 inclusive	£12,136,811
And to all other parts of America, including the British and Foreign West Indies - - - - -	10,599,514
Total for the whole of America - - -	£22,736,325

* By which the exports to Africa declined from £1,156,000. in 1805; to £409,075. in 1811.

The real value of the exports from Great Britain to the American States, average of four years ending 1811 inclusive, during which period the British Orders in Council, and American Non-importation and Embargo Laws, were in operation - - - - - - £6,464,059

And to all other parts of America, including the British and Foreign West Indies - - - - - 17,133,553

Making a total for the whole of America - - £23,597,612

In the latter period, therefore, the deficiency in the direct exports to the American States was more than compensated by an increased exportation to other parts of America, by which it would appear that, during the first mentioned period, the goods exported from hence in American vessels were by no means entirely carried to the American States, for the consumption of those States, but that a large proportion of them must have been conveyed by the Americans to the West Indies and South America; which we have ourselves since supplied directly in British ships; and that an equivalent proportion of the exports, to the British North American Colonies and the West Indies, must in the latter period have indirectly found their way into the American States to make up the deficiency in the direct importations there. Ireland, which has so advantageous a trade with this country, imports annually from hence manufactures and produce to the amount of 7,000,000 and upwards, which is probably full as much as was ever actually consumed within the American States.

Our trade to the continent of Europe has heretofore been much greater than it ever has been to the American States, and as the French Decrees exclude all British manufactures and produce from every part of the world under the influence of France, the manufactures formerly sent to those were in great part thrown upon the home and American markets, by which both would have been overstocked even if the American non-intercourse had never taken place.

The principal complaints came from the manufacturers of Birmingham, many of whom having been excluded by those decrees from the continental market, turned to the American trade, and having limited themselves to that trade only, and an immense quantity of Birmingham manufactures having been sent there in 1810, those houses, whose trade was limited, of course suffered on the American ports being shut. Several respectable persons who were examined before the

House of Lords said that, in consequence of the introduction of machinery and other improvements, the manufactures of Birmingham have within a short time more than doubled, and that the *great, unusual, and unnatural amount of business in* 1809 *and* 1810, and the great accumulation of impediments in the disposal of the commodities, acting all at once in October 1810, trade was greatly depressed. Similar continental manufactures have interfered, and are preferred and substituted in many instances, particularly in the late French, and also in the Spanish possessions in the West Indies and South America. And as long as the American States have access, contrary to all sound principle, to our East and West India possessions, they will supply them with contraband goods, and when the Continent is open to the American States, they must take in payment, continental productions and manufactures far exceeding their own consumption, and will be under the necessity of forcing a sale for them in foreign markets. Under these circumstances, therefore, Great Britain will not only find a very disadvantageous competition in such markets, but in those also of which she ought to have the exclusive supply.

Misrepresentation and misapprehension have seldom had greater effect than in respect to the Orders in Council. Real distresses, arising from different causes, were exaggerated and represented to be general, when only certain classes of manufacturers were in want of work. Yet every distress, every riot and outrageous proceeding, arising from whatever cause, were imputed to those Orders—those just and necessary retaliatory measures, without which, not only France and all the countries under her influence, but also the whole of our foreign possessions in every part of the world, would have been supplied with the manufactures and produce of hostile countries, by American shipping, creating a most dangerous competition with British manufactures. And let it not be forgotten, that our inestimable Carrying Trade, which was almost lost by the admission of neutral shipping, has been in a great degree restored by the operation of the Orders in Council!!!

Our Navigation Laws were in part suspended, with the view of exporting the manufactures of the United Kingdom by means of licenses, and the licenses obviated, in a considerable degree, the obstructions created by the French Decrees to the admittance of our manufactures.

Without those licenses, Russia, Sweden, Denmark, and all the countries under the influence of France, being hostile, our exports to those parts would have been

extremely limited or subject to great difficulty and loss. If the Orders in Council had not taken place, our enemies would have been supplied with raw materials and with articles of every description; and while *their* manufactures and produce would have been sent to all parts by neutral shipping, we should have been shut out from the Continent. As produce can be raised much cheaper in the foreign than in the British West India colonies, the countries under the control of France would be supplied in American shipping, navigating at peace freights and peace insurances, at a much lower rate, and in exchange for their own manufactures; and of course no colonial produce would be received on the Continent from hence. The West India trade was extremely depressed in 1806 and 1807, in consequence of the foreign markets being supplied by neutrals; and the latest accounts from the Havannah state that the Americans take off their sugars at good prices, and have filled their markets with French manufactures.

Our retaliatory measures have reduced the Continent to the greatest distress, insomuch that the French Decrees would have been revoked, if a mischievous and groundless clamour had not encouraged their continuance. But the repeal of the Orders in Council, while the enemy will observe neither treaty nor restriction, would give effect to all the measures of *France*, in favour of her own commerce, and to the detriment of ours; and all colonial produce would be supplied by neutral shipping.

The Non-importation, the Non-intercouse, and Embargoes, have occasioned the greatest distress and bankruptcies in the American States. The produce of that country, which would meet a ready sale in this, cannot find a market, nor could they obtain payment for the flour sent to Spain and Portugal, except by bills on England from British Commissaries in those countries; and exchange is so much against the American States, that their export trade to Europe must soon cease. One great advantage arising from exchange being so unfavourable to the American States is, that the American debt to this country has been in great part liquidated. American exports to France in 1804 are stated at ten millions sterling, but, being checked by our Orders in Council, they were reduced in 1810 to £600,000.

The evidence of the most respectable persons, and petitions from the most considerable houses in the city, and of the oldest establishments, and signed by a great number of the principal merchants, ship-owners, and traders, support and maintain these opinions respecting the Orders in Council, and express a belief that the great

body of merchants of the United Kingdom entertain the same. I am sorry to observe that, so atrocious has been the conduct of the perpetrators and abettors of the late disgraceful transactions in the disturbed counties, that they have endeavoured, by a system of terror and of assassination, to prevent respectable men, at the head of great establishments, from coming forward and giving evidence; and, to my knowledge, they have succeeded in several instances; and five chiefs of manufacturing establishments, whom they considered as unfriendly to them, have been assassinated. But the promoters of the clamour against the Orders in Council argue as if the British Government were the aggressor in the dispute with America. Yet the American Non-importation Act was passed in April 1806, with the view of obliging Great Britain to abandon the right of search. This happened fifteen months before the affair of the Chesapeak, and before any of the Orders in Council, of which they complain, were meditated. Nor have these Orders at any time been the only object of American complaint. The Orders in Council issued by the short Administration of 1806, and during Mr. Perceval's Administration, were consequent to the French Decrees, and for the purpose of compelling the enemy to revoke those Decrees, which had for object the exclusion of all British manufactures and produce from every part of the world under the influence of France; and which were enforced in the most savage manner—by forfeiture, branding, and ten years hard labour.

I have entered into details which, perhaps, may appear foreign to the subject; but it is essential to remove misapprehensions, and to prevent manufacturers from being misled by fallacious accounts of the state of commerce; and it is peculiarly essential to point the attention of those concerned to plain and simple speculations, which will best tend to their interests, and are within our control. I wish to show that those interests are comparatively little affected by the circumstances that have been so clamorously pressed upon their attention, and that the value of their commodities is, by no means, so dependant on the export trade to foreign countries as is generally imagined: it is essential also that our commercial resources should be known, and how far and how little the manufacturers of this country are dependant on a direct trade with the American States.

I wish to point out the real state of the dispute with those States; and to prevent the public from being dismayed by false and mischievous suggestions, in case that perverse and Frenchified party (by no means the most respectable nor

most numerous part of those States) should continue hostile, and that our concessions should be rejected. I wish it also to be considered that the clamours for concession to the American States cannot benefit our trade generally, but must and do encourage those States to persevere in their extravagant claims, which, if conceded, the most essential political interests will be sacrificed for uncertain, or at best transitory, advantages. The highly mischievous concessions of the most precious interests by the treaty of 1794, though possibly only temporary, should not for a moment, nor under any circumstances, have been granted.

The sure and highly improving market of the British Empire is alone sufficient to employ a vast number of manufacturers, and to consume infinitely the greater part of our manufactures. This, generally called the home in contradistinction to foreign markets, includes not only England, Scotland, and Ireland, but also our Colonies in North America; the whole of the West Indies now in our possession; the East Indies, the Cape of Good Hope, Gibraltar, Malta, and all places now occupied by us: which contains, as I conceive, nearly 30,000,000 of inhabitants,* exclusive of Indians. But were we to place any confidence in the declamations we have lately heard, it would seem that the supply of the few millions, not very opulent, scattered over the comparatively thinly inhabited country of the American States, was of more consequence than this home market, which we might completely command. Those who are so apprehensive of the loss of the American market, may recollect, that during the rebellion, and the most acrimonious part of it, the Provinces were supplied with British manufactures in preference to those of their great ally and protector France, which were most eagerly pressed upon them. Yet America never did nor ever will take from us any article with which she can possibly supply herself, nor any article which she can procure better or cheaper

* Great Britain, Guernsey, Jersey, &c.	14,000,000
Ireland	4,500,000
The two Canadas, Prince Edwards, Cape Breton, Newfoundland, New Brunswick, Nova Scotia, &c.	2,000,000
The whole of the West Indies now in our possession, including French, Dutch, and Danish	3,500,000
Gibraltar, Sicily, Malta, and the East Indies, including Java, the Isle of France, the Cape of Good Hope, &c.	6,000,000
	30,000,000

from other countries, but she will continue to take from us such merchandize and manufactures as are necessary for herself, and for her foreign commerce.

I hope it will not be supposed that my observations in favour of the home market, imply an opinion that our foreign trade will generally decrease; on the contrary, I am convinced it will greatly increase: and even if the demand for British manufactures, from the American States, should decline, I am perfectly satisfied that our commerce with South America, whose ports are not likely again to be shut against us, will most amply compensate. Our merchants have been discouraged because their first and immense shipments for Buenos Ayres did not meet a ready market. But merchandize, emptied indiscriminately from all our warehouses, was ill assorted for the country; the vast regions usually supplied from Buenos Ayres, being in a state of the most destructive warfare, and hostile to the capital, the consumption of our manufactures was confined to the population of the city. Neither the merchants of Chili nor Lima could venture to come, with their mules laden with dollars, to purchase, nor were there any means of supplying the interior: we may be assured that an intercourse with Great Britain will give rise to new wants in that extensive country, and we find that the South American market is now becoming profitable to the regular merchant.

The complaints of the manufacturers of iron and Birmingham wares have been the loudest, and the distress of those who had not full employment, especially in a time of scarcity, is greatly to be lamented. There can be no doubt, however, that no inconsiderable portion of the discontent in some districts arose from the reduction of wages, extravagantly raised by eager speculations for the South American, as well as the Mediterranean and other markets, that enabled the manufacturers to idle two or three days in the week; which reduction, unfortunately happening at the time of the extraordinary high price of bread, occasioned the distress to be severely felt. But the want of employment should be imputed to the French Decrees, and to the increase of the manufactures beyond demand, rather than to the Orders in Council; and it should be observed, that foreign markets have been glutted, and manufacturers greatly distressed, long before Orders in Council were ever thought of, and in times of tranquillity.

It has been already hinted that the prohibition of British Goods on the continent had thrown a greater quantity of our manufactures than ever went to the American States, upon the Home and American markets; and that those traders, who had

transferred and limited their dealings to the American States alone, found a large quantity of manufactures on their hands when the American ports were shut against them. But it is clear, that in consequence of the introduction of machinery and of other improvements, and by our eager desire to speculate wherever we have the least opening, we have overstocked or surpassed the demand, particularly in the manufactures of iron and Birmingham articles, which have increased so wonderfully as to have more than doubled within the last five years: and so great also is the increase in the manufacture of cottons, that were we at peace with all the world, I am convinced we have overdone the market in those manufactures; and in order that we may be less liable to be imposed on or misled, we should prepare ourselves, in the case of peace, to expect that the foreign demand for some of our manufactures, in consequence of the competition which would then take place, instead of increasing might considerably decrease; nor should we conceal from ourselves that certain iron manufactures of the continent are preferred, as cheaper and stronger, in several of the markets we frequent; and that great efforts have been made in the American States in the manufacture of iron.

I should be extremely sorry if this observation could be imputed to any indifference on my part towards the iron manufacture: there certainly is not a more hearty well-wisher to that trade than I am: it has circumstances to recommend it beyond all others; it is all labour, from the taking the ore out of the earth to the finishing of the spring of a watch, in which state it is infinitely more valuable than any metal whatever. But there can be no doubt of its continuing to flourish; it does not depend merely on fashion, nor on foreign markets; the British Empire will always require an immense supply.

The want of confidence which has prevailed; the distrust arising from bankruptcies; the alarm occasioned by the Report of the Bullion Committee; and the hostile conduct of the American States; operating together—bankers and others could not venture to accommodate the master manufacturers and persons engaged in trade, as heretofore. This want of confidence, in many instances, prevented the master manufacturers from giving full employment to their workmen, rather than the want of orders; and many thought it prudent to dismiss a number of their hands, not because they had no orders, but on account of the difficulty of obtaining money to execute orders for which they would not be paid for many months.

The complaints, as to the decline of the Woollen trade in Yorkshire, may

be answered by a comparison of the average exports of Woollens at different periods.

The average value of five years, ending the 5th of January, 1776, £4,350,941.

Average of five years, ending the 5th of January, 1789, - £3,544,116.

Average of five years, ending the 5th of January, 1812, - £5,158,338.

The export in 1811 was £4,376,000., considerably below the two preceding years of extraordinary exports, but exceeding the average exports of five years previously to the American war, and of the five years preceding the French revolution. And I learn, from the Custom-House, that the exports of Woollens this year will not be short of any former year.

The conditional revocation of the Orders in Council has occasioned a very great advance, in the West Riding of Yorkshire, on coarse goods, and even on those of rather higher prices; but middle priced and superfine cloths have not experienced much change. Cloths under 5*s.* per yard are in greater demand than those from 5*s.* to 10*s.* per yard.

We have no returns of the quantity of Woollens manufactured, except those that are milled in the West Riding of Yorkshire, which is a very small part of the whole of our manufacture of Woollens.

	yards.
On an average of five years, ending the 5th of April, 1776, the amount was - - - - -	5,369,518
On an average of five years, ending the 5th of April, 1789,	8,642,716
On an average of five years, ending the 5th of April, 1812,	14,718,825

So that on an average there is a great increase of milled cloth; and taking even the year 1811, which was supposed to be a year when the manufacture had greatly declined, we find that it exceeded the quantity milled in 1802, a year of peace, by 561,293 yards.

These returns are made to Pontefract Easter Session, and the Gentleman who makes them has just now communicated that there is a great increase of cloth milled in the quarter ending the 25th of last month, which must have been manufactured previously to the suspension of the Orders in Council.

The introduction of Spanish Sheep into the United Kingdom is a subject of such great importance, that it claims some observation. Their reputation has suddenly fallen, but I am not aware that it has happened on sufficient ground or trial. The good opinion I had formed of that breed was, however, very much checked

on hearing that a person inferior to none in respectability, real patriotism, and liberal attention to the rural economy of the British Empire; and, I may add, in knowledge of the subject,—I mean Mr. Coke of Norfolk, who has declared himself unfavourable to the Spanish breed. I understand the objection is entirely to the carcass; for the superiority of the wool over the English fine wools cannot be doubted. But Mr. Tollet, Mr. Tharp, Mr. Webb Hall, Mr. Birkbeck, Mr. Lucas, and others, who have entered deeply into the experimens, are perfectly satisfied of the practicability of growing superfine wool in these kingdoms, and that the value of the breed will revive.

The Merino wool, grown in this country, is now very readily sold at an advanced price, and great encouragement is held out in future. The additional quantity of wool these sheep produce being much more than the South-down, and in many instances double the quantity of the latter, added to the well-authenticated statements of the tendency to fatten equal to any except the Leicester breed, are circumstances strongly in their favour.

Mr. Tharp observes, that the high crossed wethers, bred by him, and exhibited at Lord Somerville's and the Merino meeting, gained both prizes for wool and fatness. As to the shape of the sheep, I have little doubt that the intelligence of our breeders will, by crossing, bring it to that form we deem most perfect.

There are two sorts of sheep in Spain, and it is said the flesh of the fine woolled sheep is never eaten in that country. They are kept merely for their wool, and on land in a miserably bad state, without any care about their feeding, consequently we cannot be surprised if their flesh is bad. It is the case in all warm countries, where they are neglected; so much so, that in the southern parts of Italy, where there is no attention bestowed upon them, the flesh is not deemed wholesome; while in Switzerland, where the pasture is favourable, the mutton is as good as any I have eaten; but I cannot suppose that the flesh of sheep of the Spanish breed, the grain of which is as fine as any we are acquainted with, properly fed from the birth, and on English pasture, will not prove excellent meat. It is not a fair trial to attempt to fatten those starved animals, landed here in the most miserable condition, and which, perhaps, never were in a much better state; but at my table, the first crosses of South-Down with Spanish have not been distinguished from the whole breed of the former.

The importation of Spanish sheep has much decreased: yet in the year, ending the 31st of December, 1811,—781 were imported into Bristol.

I am of opinion that superfine wool will be in much greater demand than ever it has been, and I do not know from whence an adequate supply can be derived hereafter. Nor does it appear to me to be prudent to discourage a breed of sheep, becoming every day more necessary to the country. The consideration of the large sums which might be saved to this country, by raising wool equal in quality to that generally imported, should induce us not to relinquish hastily an object of such importance. Thirty years attention to the subject leads me to the opinion that it is practicable, and without much stronger proofs than have yet come to my knowledge, I conceive that it would be highly imprudent to stop short in a pursuit, which in the opinion of many, is likely to answer extremely well to those who persevere. The fleece alone of these sheep is often worth more than both fleece and carcass of a great proportion of the sheep of the United Kingdom. The policy of our enemy is far different from that of abandoning the establishment of Spanish flocks in France; it seems to be one of his objects to make that country the emporium for superfine Wools.

In Ireland the growth of Spanish wool is cultivated with great spirit, sells at very high prices, and the cloths made of it are excellent. The public sale for this year has not yet taken place, but the Farming Society at Dublin has in store between 6 and 7000 fleeces of Merino, and Merino and South-Down crosses, and some native Wicklow, for which very good prices are expected. At the sale of wool at the Cork Institution, on the 24th of last month, South-Down sold from 3*s.* 6*d.* to 5*s.* 8*d.* per lb. (Mr. Aldworth); Merino from 7*s.* 5*d.* to 10*s.* 7*d.* per lb. (Mr. Barry); Crosses of Merino from 3*s.* 1*d.* to 7*s.* 7*d.* per lb. (Lord Doneraile). But how it happens that the value of the same kinds of wool is so much depressed in this country, the first in the world for the woollen manufacture, while they obtain such an encouraging price in Ireland, where the manufacture is not carried to a great extent, is incomprehensible, and such a mystery as cannot easily be unravelled. In Ireland, there is not generally a middle man, in that trade, between the grower and the manufacturer. The Irish manufacturer may have some partiality for the produce of his native country, and may, perhaps, sometimes have gone beyond its value; but it is difficult to believe that, at repeated sales of so large a number of fleeces, the general average was beyond what they were fairly worth to the manu-

facturer. If worth so much to an Irish, why not to an English manufacturer? Either the stapler or the manufacturer takes a great advantage! Yet of all middle men, the stapler seems to be the most necessary, because, if the manufacturer buys the wool in the fleece, he purchases parts which he does not want, and though the South-Down fleece is the most even, yet there are parts of it which will not suit any one kind of manufacture.

From 12 to 15,000 Spanish sheep have been landed in North America; the prices of the rams have been as high as in England, and it is declared that the imported Merinos are very hardy, and bear the climate (of Connecticut) better than the native sheep; that the lambs are strong, and only covered by a shed; that the ewes on an average give 6 lbs. and the rams 11 lbs. of wool, which sells for 5*s.* 1*d.* per lb.; that 13 millions of pounds of wool were shorn in the American States in 1811; and that 17 millions of yards of cloth were made in the same year, and sold very extravagantly, from seven to nine dollars per yard; as appears from the accounts of the American Societies for encouraging Agriculture, &c. But I am informed, the experiment, in respect to Spanish sheep, does not prosper; and the specimens of cloth I have seen were very bad. However, English wool is not very likely to suffer from the competition of that article grown in the Northern States, such as Connecticut, &c. where the snow lies four or five months in the year: at least, in this country, we could not afford to keep sheep on hay for such a length of time.

The spirited and intelligent exertions of Mr. Webb Hall, of Sneyd Park, near Bristol, must tend essentially to establish an adequate or fair price for wool of the Spanish breed, grown in the United Kingdom. He has erected large and commodious buildings for washing and sorting wool; and also a lambing-house capable of receiving from 1500 to 2000 ewes commodiously. He washes and sorts the Merino wool according to the Spanish method; and the importers of that article agree in opinion, that no wool, coming from Spain, is so well sorted and prepared as at Mr. Hall's. The want of this method of washing, sorting, and preparing the Merino wool grown in England, occasioned great difficulty in the sale of it; and, when disposed of in the fleece, the price was much inferior to that of wool of the same quality coming from Spain.

Mr. Hall, with his usual spirit, endeavours to introduce the same method in other parts of the Kingdom: he is well situated, near Bristol, which from its

neighbourhood to the cloathing counties, should be the grand mart for the sale of superfine wools.*

The object of these details is, to give such a view of our foreign and domestic trade, in wool and woollens, as may enable us to judge of the value of both. I shall now add the prices given at the late fairs in different parts of the kingdom. At Monmouth, Ryeland-wool sold at 2*s*. 3*d*. per lb. At Hereford, the price was better, the common Ryeland sold from 2*s*. 10*d*. to 3*s*. 1½*d*. per lb.; Merino crosses from 3*s*. 7*d*. to 5*s*. 0½*d*. per lb. At Ross Fair, Ryeland wool sold at 3*s*. 2½*d*. per lb.; no Spanish or Anglo-Merino wools were offered for sale. In Cheshire, wool grown on Delamere Forest has been sold from 2*s*. 6*d*. to 3*s*. per lb. Mr. Wilbraham sold at 2*s*. 9*d*. per lb. part mixed Merino, but rather more than five parts in six South-Down wool. One half mixed merino, the other half South-Down, sold at 3*s*. 6*d*. per lb. Another flock of mixed Merinos and Ryeland, with a few fleeces of real Spanish, at 4*s*. 6*d*. per lb. The fleeces average 4lb. each.

The sale of wool in those parts had been slack, and the buyers alleged as a reason, that the success of the Allies in Spain will increase the export of wool to this country. At Colchester fair, South-Down sold at 2*s*. 3*d*.; 2*s*. 4*d*.; and 2*s*. 6*d*. per lb.: Mr. Western sold at the latter price; and since the fair it has been sold at 2*s*. 6*d*. and that price has been refused. At Thetford, the wool buyers, as usual, were not disposed to buy in the fair: in the evening some was sold at 2*s*. 3*d*.; and the Merino crosses at 4*s*. per lb.;—but, since the fair, there has been a very brisk sale of the best South-Down at 2*s*. 6*d*. per lb.: Mr. Coke refused that price. The most considerable wool growers in these parts keep back their wool, in expectation that the speculations for the American market, on the suspension of the Orders in Council, will raise the value of it; and this leaves the market in an unsettled state.

I now come to the most disagreeable part of my business, that is, to give an opinion respecting the value of our wool. It appears from the statements I have laid before you, that, notwithstanding the unprecedented, adverse, and acrimonious conduct of the enemy, and the accumulation of difficulties occuring at the same time, the general trade of the British empire has prospered beyond example; that

* Mr. Hall has 2000 ewes, and during the month of September (1812) he sold his sorted wools for £2000. and upwards. His pure Merino, washed on the back of the sheep, obtained from 5*s*. to 6*s*. 6*d*. per lb.

every temporary decline of trade, in particular branches and to particular countries, has been most amply compensated by a great increase in other branches, and an increase of exports to other countries; that, however the variations and change of direction in trade may for a time, diminish profits or distress individuals; such are the energies of our commercial men, that new channels are soon struck out, manufactures are varied, and new ones adopted; that commerce seems readily to recover, and every diminution of export is fully made up on an average of a very few years. It has been remarked how inconsiderable a proportion of the whole of our manufactures is exported to foreign parts; and that the want of employment often arises from an overstock of particular manufactures, and glutted markets abroad; from all which we may draw this comfortable conclusion, that we are not liable to be essentially hurt by the machinations of the enemy against our commerce, and that we have little to fear in respect to commerce, except from party spirit and from our own mistakes. I cannot, therefore, admit that there is any reason for a reduced price of wool, unless it may be that the market is overstocked with that article; but, even in that case, we cannot put the price for the best wool below what has been given almost generally in other counties for South-Down wool, certainly inferior to our best. At the same time I should observe, it is generally said that speculations, in consequence of the suspension of the Orders in Council, had already raised woollens from 15 to 20 per cent.

I have mentioned that Mr. Western, of Essex, has sold at 2*s.* 6*d.* per lb.: Mr. Coke, and others, have refused that price. Since Thetford fair there has been a brisk sale for South-Down at 2*s.* 6*d.* per lb.

There is such a difference in the quality of our wool, that it would be ridiculous to name an uniform price; therefore, after consultation with those most capable of judging, my opinion is, that the price should be from 2*s.* to 2*s.* 6*d.* per lb., which puts the lowest price at 3*d.* per lb. less than the lowest I have heard of at any of the fairs. And I am clearly of opinion, that there is a difference of 6*d.* per lb. between our best and our worst fleeces.

I must add, that I put the prices so low in consideration of the stock of Spanish wool now in this country; of the possible effects of the late bankruptcies; and of the insulting hostile temper of a prevailing party in the American States, which no forbearance,—no concession, will conciliate; and with which if we longer

temporize, we shall deserve all the consequence of want of firmnesss, and of that conduct which alone can maintain the power and preserve the safety of the empire.

Since the fair, a considerable quantity of inferior wool has been sold at 2*s.* per lb.; but the principal wool growers seem determined not to take less than 2*s.* 6*d.* per lb. for their best wool, which, it is probable, they will obtain, when the real state of our trade is well understood.

No. XLI.

On the Culture of the real Summer Wheat. By Charles Thomas Skurray, *Esq. of Alverdiscot, Devon, Secretary to the North Devon Agricultural Society.*

It has happened rather unfortunately, that the many varieties of wheat which have been cultivated in the spring, and thence denominated spring wheats, have proved of a very inferior quality, and the growers have, in consequence, been obliged to sell it at a lower rate than other wheat. This has occasioned so great a dislike to every kind of wheat sown in spring, that it has become a very difficult matter to prevail on a mere practical farmer to sow his land with spring wheat, even if his crop of winter wheat has been destroyed by severe weather, floods, wire-worms, and the numberless accidents to which it is always exposed: he rather prefers sowing his wheat land with either barley, oats, or pulse;—of course, this system must be productive of an extra quantity of barley, &c., and occasion a great deficiency of bread corn; for wheat must be considered as the food of four-fifths of the inhabitants of England and Wales: and when there is a failure in our harvest, we are under the necessity of importing any deficiency of wheats from foreigners, and not unfrequently from our most inveterate enemies. ' The climate of Great Britain has of late years been very unfavourable to the growth of wheat, and it is easy to trace the present high prices of grain to this much to be lamented cause. The distempers to which wheat has for many seasons past been liable, are known by the name of blight and mildew. Many farms are now become so subject to one or other of these misfortunes, as to induce the occupiers to abandon the culture of wheat altogether; and numerous instances have occured, within the knowledge of the writer, where farmers of substance and respectability have been utterly ruined by the frequent failure of their wheat crops from the above causes.

It will, therefore, be my endeavour to convince the most prejudiced mind, that the valuable grain of which I am now treating, is wholly exempt from the mildew, in those seasons when common wheat is completely destroyed by it; that it is of

superior value to the miller, to the consumer, and to the farmer; that it produces a large return; and is on the whole more profitable than any other corn crop.

Before I proceed to detail the method of culture, I shall briefly state some of the great advantages to be derived from the summer wheat.

1st. It may be sown with success the beginning of May, giving thereby an opportunity of feeding off turnips and ruta baga at the most trying season, when green food of all kinds is scarce.

2ndly. It is the best of all corn as a nurse to clovers and grasses.

3rdly. It requires no extraordinary tillage or manure.

4thly. It produces a large increase, and is very much approved of by the millers.

5thly. The straw makes excellent fodder for cattle.

6thly. It is not liable either to rust, mildew, or blight, and in wet seasons is not so apt as common wheat to lodge or go down.

After many years experience, I can with confidence assert, that there is no other species of wheat which possesses these important advantages. In a national point of view the benefits to be derived from it are incalculable: instead of growing such quantities of oats and beans, let our farmers be encouraged to sow summer wheat; we shall then see fewer pampered horses; but what is of more consequence to us as a commercial nation, we shall see fewer starving poor; our labourers and manufacturers better fed, than can ever be the case while bread maintains the price it has done for some time past.

Having made these observations, merely to point out the advantages to be derived from it, I shall now proceed to the method of culture.

1st. *The Description of the Grain.*—The real summer wheat is somewhat differen in its external appearance from that sort usually called spring wheat. It is a small plump grain of a brownish cast; the bran remarkably thin, very heavy, but not what the millers term a bright sample; it has a bearded ear generally; but I suspect this depends greatly on the land, as some soils produce more and longer beards than others, while in some places the beards will in time nearly disappear:—this is a fact I am totally unable to account for. The straw is slender, but never grows very high.

The Soil.—A tenacious loam suits it well, but any soil that is not too light will yield a crop, provided it is clean, in tolerable heart, and well worked.—Wet boggy

land wholly improper. The lands in the North of Devon are shallow, light, and rocky; of course not adapted for a wheat crop. The average crop of wheat in that part of the county is about 15 bushels per acre.—The summer wheat has generally produced from 25 to 30 bushels in the same land; soil and seasons alike.

The Rotation.—After turnips, potatoes, cabbages, ruta baga, or indeed any green crop; but where the winter wheat may have failed from any cause whatever, the summer wheat is always sure to succeed. I have known it succeed well when a coarse old pasture had been pared and burnt, and sown with turnips, the turnips fed off, and summer wheat sown the end of April: also on a clover ley when ploughed before Christmas, and well worked in the spring.

Seed and Preparation.—About 3 bushels of seed per acre is the proper quantity, as it has not time to spread so much as winter wheat; but if the land is rich, a less quantity of seed will suffice; though under any circumstances, less than 10 pecks (Winchester) should not be sown. The seed must be prepared with lime and brine in the ordinary way that other seed wheat is; for be it remembered, that it is fully as liable to smut as common wheat without this salutary and wise precaution. The proper time for sowing is all April, sooner or later, according to the season.

Harvest.—It ripens about the same time as other wheat; thus in four months after sowing, it is harvested: with other wheat, ten months, and in some cases near one year is requisite to bring it to perfection. Being short in the straw, it may be mown with a scythe and bow, like barley; it is thus cut speedily, and at little expense.

Produce.—In the West of England, where the wheat crops are light, compared with other counties, the produce of this wheat is generally 10 bushels per acre more than common wheat, even when sown in the same field. The weight of a bushel, Winchester measure, in 1811, was $60\frac{3}{4}$ lbs.; but this was a year when all grain was particularly light. In some cases the writer has had it full $61\frac{1}{4}$ lbs. the Winchester bushel.

The comparative value of summer wheat may be stated at about 1*s.* per bushel above the market price of the best red Lammas wheat; in some instances, the writer has known it sold to the millers at 2*s.* per bushel more than common white wheat. But hitherto, in consequence of the growers reserving their summer wheat for seed (and which I have taken much pains to persuade them so to do), but little has been sold to the millers, and that only to ascertain its real value as bread corn.—After having proved the quality, they would have purchased any quantity of it.

The bread made from it possesses many good qualities. It remains moist long after it is baked; it rises well in the oven, and is very pleasant to the taste. It is supposed by some eminent chemists to contain more gluten, or nourishment, than common wheat; it is not, however, so white as the bread made from the flour of white wheat.

On referring to Duhamel's Elements of Agriculture, I find it there stated, that this species of grain (which he calls summer wheat) has been cultivated in France for a series of years, and the only objection to it appears to be, that the work in the spring would be too much hurried by having all the corn to sow at that season.

This, I admit, may at the first blush appear an objection, but after due consideration, it will not be so formidable as some agriculturists seem to imagine. The tedious part of the operation in preparing land is ploughing and manuring; therefore, if the winter months are employed in ploughing and carting out dung, &c. the process of sowing and covering the seed may be dispatched, when the proper season arrives, without any extra bustle or inconvenience. And instead of committing the seed into a bed of mire in the months of November and December, the lands may be previously laid up in due form to be ready to work the first dry time after the turn of Christmas.

It is much to be apprehended that the late wet autumn has obliged much land to be sown in a wretched condition, and much more to remain unsown to this day. In this case, the dependance of the farmer must be on the common wheat sown in the spring, which I know, by experience, is but a sorry dependance.—Being sown late, it of course ripens late, and has to encounter all the risks of blight and mildew: should it chance to escape these maladies, the short days commence, the sun loses its power, and the rainy weather sets in before the corn is sufficiently ripe to harvest. The loss to the farmer and the nation is obvious.

In such instances, therefore, the advantages of the summer wheat must appear conspicuous, and those who had once felt the benefit of it would act unwisely to omit sowing it every year, at least in sufficient quantity to furnish seed to their neighbours and themselves; the great difficulty of procuring that which is really good and genuine, being a strong barrier to its introduction. This wheat came into Devonshire many years ago from either France or Guernsey, and was grown more for curiosity than any other motive. It was in the hands of a few gentlemen only, when my neighbour, the late Mr. Exeter, whose practice on the drill husbandry is

so well known, procured a bushel of it for experiment sake. Not being acquainted with its nature, he sowed it at too early a period in the spring (February and March), when the produce and sample did not meet his approbation the ensuing harvest. He however sold small parcels of it to his neighbours, none of whom paid any attention to its peculiar merit. Meeting with a few bushels in the hands of a farmer, I purchased them, and after repeated experiments, I have found it a most valuable grain. So conscious now are the farmers in Devonshire of its merits, that it is bought up with avidity in the markets at a very high rate for seed; though previous to my cultivating it on a large scale, the value of it was unknown, both to the farmers and the millers. Within a few years, I have grown many hundreds of bushels, all of which I have taken pains to disseminate. Many persons who obtained small quantities of the seed to make trial, have invariably continued the culture of it on an enlarged scale, and there is no single instance in which it has been fairly tried, that it has failed to answer the expectations of the grower.

Certificates from various individuals who have grown this valuable wheat were forwarded to the London Society of Arts, with some communications from me on the subject, for which I was complimented with an Honorary Medal. The particulars may be referred to in the last volume of their Transactions, just published.

CHARLES THOMAS SKURRAY.

February 1*st*, 1813.

No. XLII.

On the Application of Springs to Carriages of Burthen, by Richard Lovell Edgeworth, *Esq. of Edgeworthstown, Ireland.*

To the Right Honourable the President, Vice Presidents, and Members of the Board of Agriculture.

Gentlemen, *February*, 1813.

Had I not received particular favour from the Board of Agriculture, their general attention to whatever is proposed upon reasonable grounds for the advantage of rural economy, would embolden me to offer to their consideration the result of some experiments and improvements which I have made upon wheel-carriages of burthen.

In a paper, which was printed in the Report of the Broad-wheel and Road-Committee of the House of Commons, in the year 1808, I suggested the application of springs to carts and waggons. I there observed, that skilful drivers placed goods that were liable to damage from the ordinary motion of the carriage, in the hinder part of the waggon, where the load projects backwards beyond the wheels, so as to permit a vibratory motion of the load, which in some measure answered the purpose of springs. This led me to think, that springs might be advantageously applied to carriages that move slowly, and that the draft would be lightened by their use in all carriages whatsoever. It is common to use springs to sumpter or baggage-carts, and to waggons that carry glass, or carriages for conveying musical instruments; but they were employed on those occasions for the safety of the load, and not with any view to facilitate the draft.

I examined the strength and weight of the springs of mail-coaches, with a view to their application to heavier carriages; but I found their weight, and what was a yet greater objection, their expense would be too considerable. Observing, however, in many instances, particularly in the shafts of gigs, that certain kinds of wood preserved their elasticity, though constantly exposed to being bent in various

directions, I constructed a one-horse cart with wooden elliptical springs, and two other carts with springs, each of them consisting of a piece of long-grained ash, five or six feet long, three inches and a half thick in the middle, tapering towards each end; and I found upon trial, that I had no reason to be dissatisfied even with my first attempt. I employed these carriages in carrying stones to roads that I was making, and I afterwards employed them in carrying manure, hay and corn, and in every kind of country work.—In every trial to which these carriages were exposed, I found the wooden springs obviously useful. On hard rough roads their superiority was most conspicuous; but even on the greensward, the draft was easier than that of carts without springs. Half a year's constant work has confirmed my opinion of their utility; and their continuance in perfect repair has given me reason to believe that they will be more durable and, consequently, less expensive than carts upon the common construction. The success of this attempt to substitute wooden for steel springs in carts and waggons, led me to observe minutely what could be ascertained by models, as to the advantage of springs, when applied to carriages in general. With this view, I repeated the experiments detailed in a paper, which I published nearly thirty years ago in the Transactions of the Royal Irish Academy, I had supported, that the application of springs would be beneficial in a very high ratio, in proportion to the velocity with which the carriage moved; and lately, in a paper which has been printed in the Reports of the Broad-wheel Committee of the House of Commons, I have countenanced that opinion. Upon observing the motion of the carts of which I am now writing, I determined to ascertain the fact more precisely, by such experiments as I could make without a very expensive apparatus. I therefore employed a machine, a description of which is given in a work that will soon appear.—The experiments tried with it are given at length in the Appendix.

From these experiments it appears, that the advantage of springs, in a model of a carriage moving at the rate of *two* miles an hour, *is more than three to one;* and when going at the rate of *four miles an hour, is nearly five to one.*

Thinking that the circular direction, in which these experiments were tried, might involve some error, another apparatus was contrived, by which the same experiments might be tried in a straight forward direction; from which it appears, that in a model of a carriage moving at the rate of *two* miles an hour, the advantage of springs is *three to one.* And when moving at the rate of *four* miles an hour, the advantage is more *than five to one.*

In comparing the experiments made with models of carriages upon a circular road, with those tried with models upon a straight road, there appears no considerable difference. The comparison, however, gives rise to many considerations, that may hereafter be useful; they are worthy the attention of those who have leisure and curiosity, and may exercise the skill of mathematicians upon a subject that has not hitherto much engaged their attention. In fact, no experiments upon models with respect to any machinery recommended to public notice, can afford such decisive practical results, nor give that conviction to the mind that arises from actual trial at large. There is always some difference between the action of working models, and the machines which they represent. The accuracy of workmanship in small pieces sometimes misleads, and sometimes the varying friction of the parts leads us into error; of these, a good mechanic may in general be aware: but there are frequently new and unforeseen circumstances, which elude our foresight in preparatory trials. Industry, patience, and bringing experiments on models to the test of reality, are requisite to give security to the result. This I have been enabled to do by means of an apparatus, which I invented several years ago, for comparing the draft of ploughs and carriages. It is described at large in a work which will shortly appear from the press.

It is sufficient to say in general, that by means of a carriage carrying a large horizontal pulley, two other carriages, whose draft is to be compared, are drawn forward by a rope which passes round the pulley: the ends of this rope are tied to each of the carriages to be compared. Vide the plate, figures A, B, and C.

If C, the machine, carrying the pulley, be drawn forward, the two other carriages must follow it; and if they are of equal weight, and equally well constructed, they must move on together, as they are drawn by the carriage with the pulley, provided the part of the road on which each of them move be equally smooth and good; but if either of the carriages that are to be compared is inferior in construction to the other, it will not keep pace with that of a better construction, but it will in a short time be left behind, till at last the better carriage will overtake the machine which carries the pulley. Now, if the carriages are replaced in their former situation, that which appeared to be the best, may have additional loading put upon it by degrees, till it nearly keeps pace with the inferior carriage, so that after a sufficient number of trials, the advantage of one over the other may be determined by weight.

This is, in fact, weighing the draft of one carriage against the draft of another; and thus, taking any one carriage as a standard, the comparative advantage of any number of carriages, ploughs, or implements to be drawn by horses, may be accurately ascertained.

By this apparatus, a cart with wooden springs was tried against a common cart: both were in the first place weighed, and the lighest had as much loading put into it, as made it equal in weight to the other. They were then fastened to the ends of a rope, which went round a pulley which was mounted, as above described, on another carriage. After a number of trials, on a road which was neither very good nor very bad, it was fairly ascertained, that the cart on wooden springs surpassed a common cart of nearly the same form, and with wheels of nearly the same size; and that it carried more than one-fifth greater loading than the common cart; that is to say, the spring cart, loaded with seven men and a boy, kept pace with a common cart loaded with six men, whose weights compared, were in the proportion above-mentioned.

To prevent any mistake that might arise from the difference of roughness in the different paths on which the carts ran, they were placed alternately at each end of the road, without any material difference being observed.*

Distance from workmen skilled in working steel springs, prevented a comparison being made between them and wooden springs; and, indeed, the time employed in these experiments, independently of expense, made it prudent to carry them no further by private exertion. Though the few experiments which are here mentioned may seem to have cost but little trouble, the whole series, with the apparatus necessary to try them, cost nearly a month's work, at four or five hours a day, to two experimenters, beside the labour of common workmen. This circumstance is mentioned merely to caution those who may wish to repeat them, that they must expect some trouble in the pursuit. May I also be permitted to add, that during a variety of occupations, I have never, for nearly half a century, lost sight of the improvement of wheel-carriages, as may appear from various publications, the first of which was printed in the Musæum Rusticum, in 1764; and that during that period, I have made upwards of three hundred experiments on that subject.

* A similar experiment as what is above described, was tried in a gravel walk with models, and nearly the same results were produced.

Having thus laid before your Honourable Board the result of an inquiry, which appears to me of extensive utility, I beg leave to point out in general,

That, if one horse out of five, which are now employed in drawing heavy burthens, could be spared, the saving to the nation would be (according to the calculations of Mr. Ward, in his excellent paper, printed in the Third Report for 1809, of the House of Commons' Committee upon Broad-wheels and Roads) nearly three millions sterling.

That, as the advantage of springs must be inconsiderable upon smooth, soft, and sandy roads, their utility may perhaps be confined to one-tenth part of the roads in England; still they may save near three hundred thousand pounds annually to the nation, with all the advantages arising from the greater supply of human food, which must arise from the saving of land now appropriated to the maintaining of horses. Supposing the saving to be only one-half or one-third of this sum, surely it is a great consideration in political economy.

It may also be observed, that the wear and tear of carriages on rough roads, will be considerably diminished by the use of springs.

That, the carriages with springs may be made much lighter than those without them, and that the weight so saved may be part of the loading of the carriage, instead of being uselessly a part of the carriage itself.

That, by such carriages, the roads will be less injured than they are at present, and that the thill-horses, though drawing heavier loads, will not be liable to the violent succussions to which they are now exposed in bad roads.

If this paper should in any degree obtain the attention of the Board of Agriculture, it may perhaps conduce to promote the adoption of a scheme, which appears to me of the utmost national importance. I allude to a proposal, which I have elsewhere made, of carrying on publicly and daily, for some months, in the vicinity of the metropolis, a system of large experiments with real carriages on a real road.

For this purpose, a piece of a common, near a great road, should be fenced off, and there, a quarter of a mile road of should be constructed on the best principles. And on this road, during two months at least, carriages upon the most approved construction should constantly be employed. Their number should be such that the traffic on this experimental road should equal that which is carried on upon the common road, with which it is compared.

Beside this, part of the enclosure should be appropriated to experiment upon large carriages of different construction, with and without springs, in the manner above described.

These last mentioned experiments might be repeated once a week for the period above mentioned, so that the philosopher, the legislator, the farmer, the manufacturer, the coach-maker, the wheel-wright, the coachman, and the carter, might satisfy himself by the conviction of his own senses, observation and understanding, of the true practical result of all that has been said, written, and tried, upon the subject of wheel carriages.

Such a large and unequivocal exposition of the truth, would put an end to many a vain and interested project. It would be the result of real patriotism—of that genuine English patriotism which generously promotes what is essential to the economical interests of the state. Here nothing is promised but what every man in England must wish to have accomplished: and a scheme is proposed, which no adventurer can turn to private advantage.

Though often deceived by designing pretenders, the English are ever ready to promote the public interest by private exertions; and as a sum, probably not exceeding one thousand pounds, would accomplish the plan here proposed, its author trusts, that he shall find public bodies and private individuals ready to fill a much larger sum than is requisite.

The author of this scheme hopes to visit London this summer, and to realize this plan; to the accomplishment of which, besides his own time, he offers a subscription of one hundred pounds.

I have the honour to be,

Gentlemen,

Your obedient humble servant,

RICHARD LOVELL EDGEWORTH.

APPENDIX.

Description of the Machinery for trying Experiments on Wheel Carriages, in a straight-forward Direction.

On a floor of forty feet long, a guide-slip was nailed to direct the carriage to be tried.

At the end of this road, an upright shaft or roller was erected, turning freely upon small pivots at top and bottom.

Round the lower part of this roller was fixed a cylinder, four inches diameter, on which was wound the cord that drew the carriage.

Round the top of the roller, which was also four inches diameter, was wound another cord, which passing under a pulley, was conducted to the height of twenty feet, where, passing over another pulley, it received a cup to contain the weights with which the experiments were to be tried.

The intervention of a moveable pulley, such as is used for clock weights, prevented the cord from twisting, and enabled the weight, which descended only twenty feet, to draw the carriage forward thirty-three feet. On this road obstacles were placed.

A small vane projected from the roller, which regulated its motion.

The carriage to be tried had two brass wheels, five inches diameter, running on a steel axle-tree: a slight frame was connected with this axle-tree, resting on two well-tempered springs. And on this frame was placed the load, or weight, to be carried.

The spring cart (D.) differs but little from any other cart, except in the application of two elastic pieces of wood, which act as springs between the axle-tree and body of the cart. These springs may be made of common ash; perhaps hickery or yew might answer better.

The springs are about three inches and a half deep over the axle-tree, in the cart, of which a drawing is subjoined, and taper toward the ends to the depth of two inches and a half. They are about three inches wide.

If heavier carts or waggons are employed, the springs must be proportionably stronger.

The springs are bolted to the axle-tree with a staple-bolt, or simply with a single bolt.

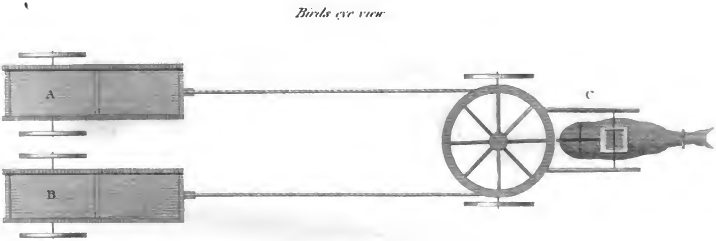
They are bolted to the hinder part of the bottom side of the cart, through a bolster three inches and a half thick. They are not bolted to the foremost part of the bottom sides of the cart; because if they were, they could not bend; but they are bolted to another spring of wood, the middle of which is bolted by two bolts to the end rail of the cart. This spring is round, except where it rests on the other springs, and where it is bedded to the front rail of the cart. By being rounded, it bends in all directions, and permits the other springs to play.

The shafts of the cart must be made to turn at the sides of the cart, and not underneath them, to permit the springs to be as long as the sides of the cart.

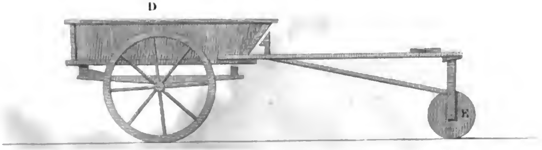
Such springs may be added to a common cart for a few shillings. In a new cart, as the whole may be made much lighter than in common, they may be fairly considered as not adding to the first cost.

The little wheel E, under the shafts in the drawing, with a brace to it, is added to support the shafts in the place of the horse during the experiment.

Machine for comparing the Draft of Carriages.



Cart with wooden Springs.



A Table of Experiments tried with the Model of a Carriage, moving on a Circular Road.

No.	Velocity.	Obstacles.	Load.	Power, or descending Weight.		Observations.
				Without Springs.	With Springs.	
1	2 miles an hour.	2 of $\frac{1}{16}$ of an inch high.	None.	Ounces. 11	Ounces. 8	These two weights are to be subtracted from those in the following Experiment.
2	Do.	Do.	2lb.	40	16	From these two weights are to be subtracted those in the preceding Experiment, thus: $40-11=29$, and $16-8=8$, which gives an advantage to springs of 29 to 8, or more than than 3 to 1.
3	4 miles an hour.	2 of $\frac{1}{16}$ of an inch high.	None.	37	28	These two weights are to be subtracted from those in the following Experiment.
4	Do.	Do.	2lb.	85	39	From these two weights are to be subtracted those in the preceding Experiment, thus: $85-37=48$, and $39-28=11$, which gives an advantage to springs of 48 to 11, or nearly 5 to 1.

A Table of Experiments tried with the Model of a Carriage, moving in a straight forward Direction.

No.	Velocity.	Obstacles.	Load.	Power, or descending Weight.		Observations.
				Without Springs.	With Springs.	
1	2 miles an hour.	15 before each wheel $\frac{1}{16}$ of an inch high.	None.	Ounces. 45	Ounces. 42	These two weights are to be subtracted from those in the following Experiment.
2	Do.	Do.	4lb.	57	46	From these two weights are to be subtracted those in the preceding Experiment, thus: $57-45=12$, and $46-42=4$, which gives an advantage to springs of 12 to 4, or 3 to 1.
3	4 miles an hour.	Do.	None.	127	125	These two weights are to be subtracted from those in the following Experiment.
4	Do.	Do.	4lb.	173	133	From these two weights are to be subtracted those in the last Experiment, thus: $173-127=46$, and $133-125=8$, which gives an advantage to springs of 46 to 8, or more than 5 to 1.

No. XLIII.

On a Remedy against the Ravages of the Fly on Turnips, and Swedish Turnips. Communicated to the Board by Thomas Greg, *Esq. with the Approbation of the Earl of* Thanet.

London, 23rd March, 1813.

Sir,

I received the letter which you did me the honour to address to Albany, by the directions of the Board of Agriculture; and take the earliest opportunity to convey to the Board the Earl of Thanet's consent, that the subject matter of his letters to me, of the 11th of August, 1811, and 27th of February, 1812, should be laid before the public, through the medium of the Honourable Board over which you preside.

I also annex extracts of two letters which I had the honour to receive from his Lordship, dated the 7th and 10th of this present month.

These, I hope, will prove an additional incitement to the landed interest to cultivate that most valuable bulb, the true ruta baga, or yellow Swedish turnip.

As the Board seems desirous of promoting the general increase of turnips, I have also annexed an extract of a letter from Mr. Reeve, of Wighton, in Norfolk, (a most respectable man, and who stands high on the list of examplary farmers), to prove, that this plant may be successfully applied to feeding every kind of domestic animal, to the great saving of corn.

As the Board does me the honour to request I should make known to them the experiments I have made with lime, under the directions of the Earl of Thanet, particularly how and when it should be slacked, and how and when applied,—I shall, in conformity to their request, give in detail my own experiments thereon.

I had the honour of paying Lord Thanet a visit early in the spring of 1811, at which time he had began to sow Swedish turnips.

On that part of the field which his Lordship mentions as having failed, the application of lime was omitted, at my particular request, the better to demonstrate the infallibility of the experiment.

Upon my return to Coles, I ordered lime to be laid upon the headlands, proportioning the quantity to the length of the lands.

The weather was fine, and the lime did not fall by the atmosphere, but was slacked as used, and sown by hand over a 40-acre piece of land.

I ordered every day's sowing to be watched, and the lime to be applied as soon as the turnips came up, in the same daily rotation as they were sown, which was 5 acres per day.

But as Lord Thanet properly observes, "to have any experiment made, you must see it done." This remark was verified. By the neglect of the bailiff in my absence, who delayed spreading the lime on the first and second day's sowing, until the third day's sowing was ready, which delay and mistaken economy in labour, exposed the first day's sowing to the ravages of the fly.

But this circumstance I cannot lament, as it furnished additional proof of the efficacy of the lime, and procured the correct execution of my orders upon the remainder of the field, which 35 acres were covered with healthy plants.

In the year 1812, I repeated the same process, with the same success; and I have not the least doubt, but lime is an infallible protection to the infant turnip, if rain does not immediately succeed the sowing. If it does, on the return of fair weather, I should recommend a repetition.

The casting of lime by hand produced considerable inconvenience to the men, in consequence of which the work was not well performed: however, under that disadvantage, the turnips sown upon 40 acres of land, in 1811, were so abundant, as to support 500 Down sheep, about 6 cows, and 30 hogs, until May, 1812; and the crop of 1812, consisting of the same number of acres, will, I have no doubt, support an equal stock to the same period.

Impressed with the importance of the application of lime, and finding it necessary to deposit it with great accuracy, I turned my mind to machinery to effect that purpose.

Without troubling the Board with a detail of experiments, it is with great satisfaction I am enabled to inform them, that by adding an horizontal motion into the top hoppers of a common drill, and substituting small shovels instead of cups into the lower, I produced a regular discharge of the lime.

For dusting turnips in rows, the common seed tin pipe may be used. For broadcast, they are taken away, and a board, about 18 inches wide, substituted in their place.

This board must hang upon an inclined plane, and should be tinned, to facilitate the fall of the lime.

When the atmosphere is damp, the lime will hang upon the board, unless a concussive motion is given to the board, by a crank.

The lime should not be slacked or sifted until the apparatus for sowing it is in the field; for the least damp will change it from a prepared state of powder, and interrupt a regular discharge.

It is not at present in my power to make any further observations to the Board upon this very important branch of agriculture.

The pride I feel in having introduced that invaluable plant, the ruta baga, into England, in the year 1783, will be much increased, should my subsequent endeavours be instrumental in protecting and facilitating the cultivation of a plant, for which I must naturally feel a kind of parental interest.

I have the honour to be, &c. &c.

THOMAS GREG.

To the Right Hon. Sir John Sinclair, *Bart.*
President of the Board of Agriculture.

Extract of a Letter from the Earl of Thanet *to* Thomas Greg, *Esq.* *dated Hothfield, 4th August,* 1811.

My Dear Sir,

I would not have allowed any circumstance to have prevented my giving you an earlier answer to your queries respecting lime, if it could have been of service to you this season. I am glad to find you think well of the practice. I have almost persuaded myself of its infallibility. I can positively assure you, for these three years, I have only had occasion to sow a second time one half acre; and that half acre was the only part not limed, from the circumstance of not having enough to cover it. My Swedes are beautiful—sown at 27 inches wide, and completely covering the ground. Yet I almost suspect my own account of my success, when I confess, that if I were to be absent from home, I could not rely upon the work being done. My turnips are sown all in the Northumberland manner: the quantity sown a day from two to three acres. They naturally come

up in succession, which facilitates the business of liming. I have generally at the time hay-making going on, and as it is seldom necessary to do any thing to the hay before nine o'clock, I employ some of the men and boys two or three hours in the morning in spreading the lime.

It is very unpleasant work, and I have suggested to those employed, in vain, to use crapes to guard their eyes; but here the people are used to spread lime, and they do not appear to suffer more in spreading by hand, than the way they are used to, of spreading with a shovel out of a cart.

The lime is put down in heaps round the field, in the most convenient places, that they may not always have to go back to the same heap. Each person has a bucket or basket, and strews the lime by handsful down each row. In windy weather, or rain, it cannot be done; but at those times I suspect the fly is not dangerous.

I have known rain follow the operation immediately, and it then seems as if little or no good had been done; but I never repeated the dose on that account: and upon such occasions, I have heard my people say, it would burn the plants, though I never saw the crop injured, or the fly succeed afterwards.

Where I have had turnips broad-cast or drilled upon flat ground, I have had the lime spread out of a cart by a shovel, and in that way, I have probably used thirty or forty bushels per acre; whereas, in the other method, it takes up about six. I am not nice in the quantity, because I consider it an additional dressing to the land. My first question is, when my turnips are coming up, whether any of the ground has been limed?—and, before they are sown, where is the lime?

I have now, besides my Swedes, 40 acres of common turnips, part began hoeing, all up, and without a speck, except upon one of the headlands, upon which the fly had begun, but which I have no doubt the lime will conquer.

I have known the fly to have attacked my turnips in former years, before the lime was applied, from neglect, in spite of all my precautions; but I have always seen it overpowered by lime. That this country is subject to the fly you may take as a proof, that there is hardly an instance of any body getting Swedes from the first sowing, or even common turnips; and before I adopted this practice I was in the same situation.

A tenant of mine this year has limed a piece of Swedes, and has, next to my own, the finest prospect of a crop that I see any where else. He had in former years been under the necessity of sowing twice, and too happy if he had a crop after

all. I recommended to him the lime, upon the argument I thought most likely to prevail. Take into consideration the expense of a second sowing, and compare it with the probable cost of lime and labour, and the result was, he not could grudge the expense, if he obtained a crop in the first instance; and ended by trying the experiment.

Extract of a Letter from the Earl of Thanet *to* Thomas Greg, *Esq. dated Hothfield, February 27th,* 1812.

My Dear Sir,

I am happy the experiment of lime to preserve turnips has answered so fully the expectations I had induced you to form. It never has failed as far as I have practised it three or four years; and I think I gave you, in the letter you allude to, a remarkable instance of having once from negligence omitted to cover a part of a field of Swedes. That part was sown a second time, whilst the other was saved. A tenant of mine in this neighbourhood adopted this practice last season, and was amply rewarded by as fine a crop, both of Swedes and others, as could be seen.

I should add, at the same time, others who have practised it at my recommendation, say, they have been disappointed.—But I am apt to think they are slovenly people. What my tenant did, I saw was properly done, to my knowledge.

Extract of a Letter from the Earl of Thanet *to* Thomas Greg, *Esq. dated Hothfield, March 7th,* 1813.

My Dear Sir

I have nothing to add to what I have said upon the subject. Uniform success has made me confident, but I have heard of others not finding the remedy effectual. I have had a most magnificent crop of Swedes this year: 24 Scotch bullocks have been four months eating two acres of Swedes. I am afraid to say they have eaten more than one bushel per head per day. It was part of an old meadow lately broke up, and the first time of being turnips in rows, and the turnips so large they almost touched each other; weighing, I really believe, upon an average, from ten to fourteen pounds each. They were literally solid ridges of turnips.

Extract of a Letter from the Earl of Thanet *to* Thomas Greg, *Esq. dated Hothfield, March 10th*, 1813.

Dear Sir,

I was in a great hurry when I returned you the enclosure, and I believe forgot to say that I had no objection to your intended communication to the Board of our lime experiment. I believe also, I made a mistake in stating my wonderful turnip crop. Upon calculating the amount, it turned out either 45 tons per acre, supposing the cattle consumed one bushel and a half for sixty days; or 54 tons if they consumed the one and a half bushel the whole time, as the men attending them declare. I was anxious to correct this exaggeration.

Extract of a Letter from Mr. John Reeve *to* Thomas Greg, *Esq. dated Wighton, in Norfolk, February 16th*, 1810.

Dear Sir,

I have had 22 beast (averaging 46 stone) at Swedes eleven weeks to-morrow, and they have not eaten more than nine acres, and I think are feeding as fast as I ever saw beast feed on any keep whatever.

I have now 45 beast and cows upon them, 13 calves, 22 rams, besides giving them to 24 horses, and I think I have a sufficiency for nine weeks longer for the whole of them; and in addition, I feed my hogs with them.

Our common turnips in this county are much injured by the frost, and those remaining have lost all their fattening quality: now the value of Swedish turnips in this district will become pretty generally known by my being fortunate in having so many this season.

No. XLIV.

On the Improvement of Chat Moss. By W. Roscoe, *Esq. In a Letter addressed to the Right Hon. Sir* John Sinclair, *Bart.*

Allerton by Liverpool, March 29, 1813.

Herewith I have the honour to transmit you some account of my proceedings towards the improvement of Chat moss, which I have to request you will have the goodness to lay before the Board of Agriculture, whenever it may suit your convenience.

I confess I have not ventured to make this communication without considerable hesitation, being apprehensive, that I may appear in the opinion of those who are much better acquainted with such subjects, to have acted too much upon my own judgment; and not to have availed myself sufficiently of the successful experiments made in other parts of the United Kingdom. I am also aware, that the results I have stated, cannot be considered as complete or satisfactory; and that it will yet require a few years to determine, with accuracy, the benefits to be derived from similar improvements. That under proper management, these benefits would be very considerable, I have, however, no doubt. I have therefore been induced to comply with the wishes of the Board in giving the best account in my power; and shall, at all times, be happy to answer any other enquiries which they may do me the honour to make.

Since I drew up the account sent herewith, I have reason to believe, that the whole moss will be cultivated in much less time than I expected; having contracted to sell 1000 acres to Willis Earle, Esq. a very spirited agriculturist in this neighbourhood, who, I have no doubt, will engage in it upon a large scale. From our joint efforts, combined with those of R. H. Bradshaw, Esq. M. P. one of the representatives of the late Duke of Bridgewater, to whom a considerable part of the moss belongs, and who is making a rapid progress, I now flatter myself, that in the course of a few years, the whole of this extensive tract will be effectually improved.

I have the honour to be, &c. &c.

W. ROSCOE.

An Account of the Drainage and Improvement of Chat Moss, in the County of Lancaster.

SECTION I.

Former State of Chat Moss.

THE tract of land called Chat moss, lies between the towns of Manchester and Warrington, in the county of Lancaster, being about six miles distant from each of those places, and nearly bordering upon the north-west side of the great turnpike road between them. On the south-east side runs the navigable river Irwell, which unites with, and loses its name in that of the Mersey at Irlam, within a short distance of the moss. The principal part of this tract lies in the township and royalty of Barton upon Irwell: the whole length of the moss is about six miles, and its greatest breadth about three miles.

During what length of time this tract of land has remained in an uncultivated state, it is not now possible to ascertain; but sufficient evidence remains, that it has at some former period exhibited a very different surface. It is certain, that a part of the moss was at one time imparked by the name of *Barton Park.* During the present improvements, the ancient oak palings have been found under-ground, in cutting the drains of the moss, in an almost regular series; besides which, the boundaries of the park are indicated by a mound, which may yet be traced, and which comprehends a tract of about four hundred acres.

It may also be observed, that in the map of the county Palatine of Lancaster, by Robert Morden, in Camden's Britannia, the impalement and inclosure of Barton Park, are shewn in the same manner as those of Knowsley, Latham, and many others in the neighbourhood; and the limits sufficiently agree with the boundaries before stated.

There is, however, reason to believe, that even at the time a part of this tract was thus enclosed, other parts of it was nearly in its present state, and had been so for many ages. It is related by Leland, that at one period the moss had grown to such an height, that a considerable portion of it became moveable, and falling into Glaze Brook, was thence carried into the river Mersey. Camden repeats

this somewhat differently—"a considerable part of the moss," says he, "was in "the memory of our fathers, washed away by a river flood, not without great "danger; causing also a corruption of the waters, which destroyed a great part "of the fish in those rivers"—(the Irwell and Mersey). Now, as Chat moss lies upwards of thirty feet above the level of the river, and is separated from it by a strong clay soil; it is scarcely credible, or indeed possible, that the river could at any time have risen to such a height as to carry away any portion of the moss. The most probable mode of accounting for this circumstance is, that the moss having vegetated to a considerable height, and having by long continued rains, and other causes, been saturated with water, dislodged some portion of its surface into Glaze Brook, a small stream which runs along the south-east side of the moss into the Mersey. Instances of this have occurred in other parts of the kingdom, particularly at Solway, where nearly the same effects have been produced, not by river flood, but by long continued vegetation surcharged with water, which must eventually be relieved by some operation of this kind.

The last mentioned author, in mentioning Chat moss, has entered into a brief enquiry into the causes that have produced this and similar tracts; and as from the nature of the work in which he was engaged, he must have had great experience on the subject, I shall quote what he says upon it.

"In this place (Chat moss) there lies a valley watered by a small river (proba-"bly the stream called Boiling Brook, which flows into the Irwell near Fox-hill,) "and here trees have been discovered lying flat in the ground; so that one would "think, that when the earth lay unhusbanded, the ditches also unscoured in these "low plains, and either by neglect or depopulation, the water passages were stopt "up; those grounds that lay lower than the rest, were converted into such boggy "mosses, as we call them, or else into standing pools. If this be true, there is no "reason to admire, that so many trees in places of this nature throughout England, "but particularly in this county, should lie overwhelmed, and as it were, buried in "the ground: for when the roots of them were loosened, by reason of the too "great moisture of the earth, 'twas impossible but they should fall, and so sink and "be drowned in such a soil." This theory seems sufficiently to agree with the authorities quoted by Dr. Rennie, and with his ingenious reasonings on the formation of peat moss, which he attributes to the stagnation of water at a low temperature. The stretch of land lying between the moss and the river is of such a

nature, as would effectually confine the water, if the proper channels to the river were not kept open; and doubtless the obstruction of these channels, by accident or neglect, has been the proximate cause of the formation of the moss.

These, however, are not all the circumstances deserving of notice on this subject. From the situation of Chat moss it is peculiarly liable to an influx of water, which if not carried off, must inevitably occasion the result we are now considering. From the adjoining high grounds in the township of Worsley, under which lie the Duke of Bridgewater's coal mines, it is probable, that considerable quantities of water are subterraneously conveyed, which meeting with a substratum of clay, rise up towards their level, and have for ages overflowed Chat moss, and contributed to the increase of its vegetation. In various parts of the moss there appeared, previous to the present drainage, many places, called by the neighbouring inhabitants ring pits, from which a continual stream of water issued, and diffused itself over the rest of the moss. These pits were supposed by the country people to be of an unfathomable depth, but in fact they only extend to the substratum of clay, and are merely vents at which the superabundant water forces up a passage. In another part of the moss, the small stream called Boiling Brook suddenly disappears, but at the distance of about fifty yards rises up again; having doubtless traced for itself a channel between the moss and the clay. If in addition to this influx of water from the Worsley hills, we advert to the quantity of rain occasionally falling on so large a surface, and consider the outlets to the river as stopped, we shall be at no loss to account for the formation of the moss, upon those principles which have been so fully explained by different writers, and are now sufficiently understood.

SECTION II.

On the Composition of Chat Moss.

Chat moss is entirely composed of the substance well known by the name of peat, being an aggregate of vegetable matter, disorganized and inert, but preserved by certain causes from putrefaction. On the surface it is light and fibrous, but becomes more dense as we penetrate into it. On cutting to a considerable depth, we find it black, compact, and heavy, and in many respects resembling coal. There is not throughout the whole moss the least intermixture of sand, gravel, or

other material; the entire substance being a pure vegetable. The depth of the moss may be estimated from ten to upwards of thirty feet.

That water in a state of stagnation, and a certain temperature of air, are favourable to the formation of peat, is certain; but the immediate cause of peat moss appears to be the plant called *Sphagnum palustre*, or broad-leaved bog moss (Sphagnum latifolium of Dr. Smith—Flora Britan. 3, 1145): without which, I am inclined to believe, that not a single instance of this kind of land would exist. The very singular nature of this plant deserves particular notice. A figure of it is given in the Flora Danica, tab. 474; and its curious fructification is figured and described by Hedwig in his Historia Muscorum frondosorum, pl. 1, fig. 1.

The height to which this plant grows, varies from an inch, to three or four feet, according to its situation. It is, strictly, an aquatic; and although it will exist in situations where it is occasionally supplied with moisture, yet it grows freely, and is produced in great quantities, only where immersed in water. It consists of a thread-like stem, set with small pointed leaves, terminated in a globular head, which contains the seeds. When found in dry situations, these leaves are dense, short, and compact; but when it grows freely in wet places, they are distant and scattered. It is only of annual growth, but as the seeds fall, they vegetate again in the ruins of their predecessors, if indeed they require any other nutriment than the water in which they are mostly found. Thence they rise to the surface, where the small heads are seen floating, and where, having ripened their seed, they again give way to their successors, annually adding their substance, as they become disorganized, to the preceding mass. This substance may, in many parts of Chat moss, be found in its regular *laminæ;* the deposition of each year being perfectly distinct and divisible. The thickness of these decreases with the depth of the moss, till at length they become indistinct and inseparable, and form a homogeneous substance.

But although the *Sphagnum palustre* be the plant to which the formation of mosses is chiefly to be attributed, it is by no means the only one found in such situations. On the contrary, mosses in general support a considerable variety of plants, which may be divided into three distinct classes, according to the state of the moss, with regard to its humidity. The wettest part is chiefly occupied by the *Sphagnum palustre*, intermixed with other *mosses*, *Lichens*, and *Scirpi*, and interspersed with the three English species of the *Drosera*, or *sun-dew*. As the moss becomes more consolidated, a different kind of plants possess themselves of it,

amongst which the principal are the various kinds of *Junci*, *Eriphorum polystachion*, and *vaginatum*, *Nardus stricta*, *Narthecuim ossifragum*, and many of the *Carices*. But it is not till the moss has acquired a considerable degree of solidity, that it appears capable of bearing the ligneous or fruticose plants. When this has taken place, we find the whole surface thickly covered with the *Erica vulgaris*, *tetralix*, and *cinerea*, the *Ledum angustifolium*, *Vaccinium oxycoccos*, *myrtillus*, and *uliginosum*, forming a complete cover, often of considerable extent.

It may perhaps be thought that the parts of the moss thus in some degree consolidated, are more valuable than the rest, as affording a better substance, and being more easily brought into cultivation; and undoubtedly inasmuch as they require less drainage, and may sooner be worked upon with horses, they are preferable to other parts of the moss. In other respects, however, they are only upon an equality with them: the substance is entirely the same; they must be subjected to the same process; and in the following statements, I shall consider the moss as of the same consistency throughout, and apply my remarks accordingly.

SECTION III.

Drainage.

It is now nearly twenty years since I began, in company with Mr. Wakefield, the drainage of Trafford moss; a tract of about 300 acres, lying two miles east of Chat moss. At that time, little was known on the subject, in comparison with what has since been discovered. We engaged in the undertaking with great ardour, and no small expense. Large drains were cut in various directions; other drains, forming the boundaries of fields, opened into the main sluices, and these fields were again intersected with smaller drains, at twelve yards distance from each other. These small drains were cut with a spit, or narrow channel, in the bottom, and covered with peat sods. It is an effectual, and durable mode of drainage on moss lands, the sods being almost indestructible; and many of these drains are yet as perfect as when first made.

That this method must answer the purpose cannot be doubted, but it was liable to two great objections.—It was too tedious, and, from the great number of drains, too expensive. Having, therefore, purchased Mr. Wakefield's interest in Chat

moss, I found it necessary to adopt a more expeditious method, and such as might accomplish the object I had in view with less expense. The reasons upon which I acted, and the method I adopted, were as follows.—

I had frequently observed, on the borders of the moss where peat had been gotten, which is generally done by cutting down the substance of the moss to the depth of ten or twelve feet, leaving the moss itself, or what is commonly called the moss head, standing, like a perpendicular wall; that from the part so cut down, the moss had drained to a considerable distance, and frequently opened into great chasms or chinks, which became smaller according as they receded from the margin of the moss head. These chasms, which diminish from an opening large enough to take in the human body, to the size of the hand, often extend from fifty to a hundred yards upon the moss head. From this it was evident that the moss had thus been drained to a certain extent, and that very frequent drains were not necessary. To what distance a drain might act, I could not precisely ascertain, but from what I had observed, I conceived that if each drain had only to draw the water twenty-five yards, they would, within a reasonable time, undoubtedly answer the intended purpose, and I therefore laid out the whole of the moss on the following plan.

I first carried a main road, nearly from east to west, through the whole extent of my division of the moss. This road is three miles long and thirty-six feet wide. It is bounded on each side by a main drain, seven feet wide and six feet deep, from which the water is conveyed by the ancient tunnels under the turnpike road, with a considerable fall, to the river. From these main drains, other drains diverge, at fifty yards distance from each other, and extend from each side of the main road to the utmost limits of the moss. Thus, each field contains fifty yards in front to the main road, and is of an indefinite length, according as the boundary of the moss varies. These field-drains are four feet wide at the top, and one foot at the bottom, and four feet and a half deep. They are kept carefully open, and as far as my experience hitherto goes, I believe they will sufficiently drain the moss, without having recourse to under draining, which I have never made use of at Chat moss, except in a very few instances, where, from the lowness of the surface, the water could not readily be gotten off without open channels which might obstruct the plough. The expense of cutting out peat moss is, in general, $1\frac{1}{2}d.$ per cubic yard.

Such is the whole account of the drainage of Chat moss. In fact, the drainage of a moss, where there is a sufficient fall for the water, (without which such an

undertaking is seldom or never advisable), is the least difficult part of the business. The drains need not to be nearer to each other than is frequently the case with the ditches and water courses in other lands; and I am well convinced, that in a certain period of time, drains at one hundred yards from each other, if made of a proper depth, would produce a sufficient effect. The length of time that these would require, renders it, however, not desirable to rely upon them, except in cases where there is a considerable extent to work upon, and the part so in drainage will not be required for many years.

Whilst I have been engaged in this undertaking, I have been well aware of the great advantages which have been derived from the method of drainage first practised by Mr. Elkington, in situations where it can properly be adopted. In the commencement of our undertaking, it occurred to Mr. Wakefield and myself, that as the water with which the moss was overcharged, probably flowed from the adjacent high lands at Worsley, it might be practicable to intercept it in its descent, by proper trenches, so as to drain the moss by one operation. With this view, we engaged the late Mr. Elkington to survey and examine Chat moss; but on considering the subject, he gave us no hopes that such an attempt would be successful. Independent of the difficulties that would have attended it, we were not the owners of the intermediate lands; and even if we had discovered the track by which the water flowed into the moss, and had diverted its course, the immense quantity of water with which it is saturated, added to the continual increase by rain, would have rendered it necessary to proceed with the drainage in detail. I did not, however, fail, as soon as I entered on the undertaking, to bring up deep drains to the overflowing feeders of the moss, called ring pits, so as to keep the water in them several feet below the surface; and in many instances I have since filled them up, and find such places as dry as any other part of the moss.

It would be unjust not to mention, that in the course of these operations, I derived considerable advantages, from the judicious remarks of Mr. Wm. Aiton, of Strathaven, in his tract on the Cultivation of Peat Moss; in consequence of which, I was induced to diminish the size of the drains, which was a saving of great expense.

SECTION IV.

Cultivation.

The usual mode of cultivating moss lands in the county of Lancaster, is by what is called paring and burning. A thin furrow is pared off by the skim-plough, if the moss will bear horses; or by the push-plough, or breast-plough, worked by a man, if the moss be too soft for that purpose: the sod or furrow is then burnt, and the ashes, being mingled by a subsequent ploughing with the substance of the peat, a tolerable crop of oats is produced.

But although this may be denominated cultivating, it is by no means improving moss; on the contrary, the first crop is generally the best. A course of burning, in a few years, produces a great quantity of inert and insoluble matter, which deteriorates, instead of improving the soil; and even the lowering the level of the moss, by destroying every year a part of the surface, is, in some situations, a serious injury: hence it happens, not unfrequently, that mosses cultivated in this manner are abandoned, in a few years, and return to a worse state than they were in before any attempt was made to reclaim them.

It appeared to me, therefore, that the real improvement of moss-land, could only be effected by the introduction of calcareous substances, of which lime and marl are the principal. I have used both in considerable quantities. On Trafford moss I have a tract of sixty acres, which has been entirely reclaimed by lime, and which has now been in cultivation many years, and borne crops of potatoes, clover, oats, and wheat, equal to any of the adjacent lands. This tract is advantageously situated on the south side of the Duke of Bridgewater's canal from Manchester to Worsley, about four miles from Manchester; and in consequence of the facility of obtaining manure by water carriage, I have laid the whole down for meadow grass, and have every reason to expect it will be productive.

By marl, we mean, in Lancashire, a combination of clay with a calcareous substance, and consider it valuable in proportion to the quantity of that substance it contains. It is generally found of a brown red, but sometimes of a pale blue or grey colour, and occasionally the two kinds are intermixed, as is the case at Chat moss.

The action of these substances upon moss land is, however, extremely different; lime possessing a caustic as well as calcareous quality, seems to destroy the vegetable fibre of the moss, and convert it into a black friable earth, much more dry than that which is formed by the application of marl. Its operation is very durable; even at the distance of fifteen or twenty years, it is scarcely possible to take up a portion of moss soil, where lime has been used, without finding the particles of that substance, intimately intermixed in small white spots through every part of it: upon such land, crops of hay, turnips, potatoes, oats, barley, and even wheat may be produced, with a quantity of animal manure, not more than is required in other cases, and at less expense in labour than any of the other kind of land. The mixture of marl with moss is much more intimate, and is probably effected by some degree of chemical union. If a piece of marl is suffered to lie undisturbed on the moss for a few months, it will be found, on taking it up, that a considerable portion of the moss will adhere to it; and if this intermediate substance be examined, it will appear to be a mixture of marl and peat, formed into one mucilaginous mass of a dark colour, and as smooth to the touch as soap. As the marl dissolves on the moss, this union takes place throughout, and a permanent improvement is effected by the conversion of an inert and useless substance, into the best of all possible soil.

It is, however, important to observe, that in the use of marl, much depends on the state of the moss at the time it is set on. Moss, in a recent state, contains a considerable portion of acid; and if the marl be applied before this is exhausted, the union will be much more rapid and intimate than if the moss be dry, and the acid suffered to evaporate. For this reason, moss lands that have been exhausted by burning, or ploughed in the heat of summer, are much more difficult to reclaim, than lands which have been marled immediately after their first ploughing. Even those tracts of land, of which there are some on Chat moss, where turf has been gotten by the surrounding inhabitants for firing, and which have consequently been turned over to a very considerable depth, although they were supposed to be the best for cultivation, have been found to derive advantages from marl more slowly, if not less effectually, than the other parts of the moss.

Both lime and marl are generally to be found within a reasonable distance, and the preference given to either of them, will much depend upon the facility of obtaining it. The quantity of lime requisite for the purpose, is so small in proportion to that

of marl, that where the distance is great, and the carriage high, it is more advisable to make use of it; but where marl is upon the spot, or can be obtained in sufficient quantity, at a reasonable expense, it appears to me to be preferable.

It would be useless to detail the various experiments which I have made, during a series of years, to bring moss land into cultivation, at as little an expense as possible. I have endeavoured to obtain crops of potatoes in the lazy-bed way, by digging in the first sod covered with vegetation, as is said to be done in Ireland. I have drilled in crops of grain and turnips, by a machine which scatters the seed with the manure. I have tried, to a considerable extent, the effect of cropping with peat-ashes, burnt in close fires; I have occasionally made use of only a small portion of marl, under an idea, that it might be found sufficient to answer the purpose. In all these attempts I have been in a greater or less degree disappointed; and in the result I am thoroughly convinced, that all temporizing expedients are fallacious; and that there is no method of improving moss land, but *by the application of a calcareous substance in a sufficient quantity to convert the moss into a soil, and by the occasional use of animal or other extraneous manures*, such as the course of cultivation, and the nature of the crops may be found to require.

Under these convictions, I have for some time past adopted a regular system or routine of improvement. After setting fire to the heath and herbage on the moss, and burning it down as far as practicable, I plough a thin sod or furrow, with a very sharp horse-plough, which I burn in small heaps and dissipate, considering it of little use but to destroy the tough sods of the *Eriophora*, *Nardus stricta*, and other plants, whose matted roots are almost imperishable. The moss being thus brought to a tolerable dry and level surface, I then plough it in a regular furrow six inches deep; and as soon as possible after it is thus turned up, I set upon it the necessary quantity of marl, not less than two hundred cubic yards to the acre. As the marl begins to crumble and fall with the sun or frost, it is spread over the land with considerable exactness, after which I put in a crop as early as possible, sometimes by the plough, and at others with the horse-scuffle or scarifier, according to the nature of the crop, adding, for the first crop a quantity of manure, which I bring down the navigable river Irwell to the borders of the moss, setting on about twenty tons to the acre. Moss land thus treated, may not only be advantageously cropped the first year with green crops, as potatoes, turnips, &c. but with any kind of grain; and as wheat has, of late, paid better to the farmer than any

other, I have hitherto chiefly relied upon it, as my first crop, for reimbursing the expense.

Expense of improving and cropping an Acre of Land on Chat Moss, with the Amount of the Produce, 1812.

	£.	s.	d.
Ploughing and burning the first furrow - - -	1	5	0
Second ploughing - - - - - -	1	0	0
200 cubic yards of marl, at 11d. per yard per contract, for which the marl is gotten, conveyed, and spread upon the land: to which add 1d. per yard for feighing or uncovering the bed of marl, 1s. per yard	10	0	0
20 tons of Manchester manure, at 2s. 6d. per ton; allow for conveyance and setting on 2s. 6d. - - - - -	5	0	0
Third ploughing, sowing, and harrowing - - -	1	0	0
Seed wheat, 2 bushels, at 21s. per bushel - - -	2	2	0
	20	7	0
On one piece of land thus improved, I had twenty bushels, Winchester, of mixed red and cone wheat, which at the time it was reaped, would have sold at 1l. 1s. per bushel - - - -	21	0	0
On another piece I had 18 bushels and a half of red wheat, worth 1l. 1s. per bushel - - - - - - -	19	8	6
On 4 acres of land which had been broken up before, but not having been sufficiently marled, had produced a poor crop of spring wheat, and which I had therefore marled again; I had a crop of beans of 32 bushels to the acre, worth 12s. per bushel - -	19	4	0

These crops, with the value of the straw, have returned in the first year the full expense, and the land is now sown again, chiefly with another crop of wheat.

It is obvious, however, that this statement, must not, for many reasons, be taken as the average of expense and return in improving the moss. The previous drainage and proportion of general charges is omitted; the prices of produce are stated unusually high, and the crops were the best upon the moss; so that, upon the whole, I apprehend the average return for wheat ought not to be estimated at

above 15l. per acre. Oats, beans, and clover, of which the rotation of crops consists, from 10l. to 12l. per acre: but even this, or indeed a still lower estimate, would be found to yield a very speedy return for the money expended in the improvement.

I must also observe, that it would be impracticable to effect the marling at so cheap a rate, were it not for the assistance of an iron road or rail way, laid upon boards or sleepers, and moveable at pleasure. Over this road the marl is conveyed in waggons, with small iron wheels, each drawn by one man; these waggons, by taking out a pin, turn their lading out on either side; they each carry about 15 cwt., being as much as could heretofore be conveyed over the moss, by a cart with a driver and two horses.

I am well convinced, that a road of this kind would be of great use upon other farms, as well as moss lands, in diminishing the expense of horse labour; and would be found particularly advantageous in setting on marl or manure in the winter, without cutting up the land.

In 1810, I put a flock of South Downs upon the moss, which have been remarkably healthy. The astringent and antiseptic quality of the moss, seems to prevent the foot-rot, to which they are liable on other lands.

I am now preparing to lay down several acres with fiorin grass, of the utility and advantages of which I am fully convinced; and with the means of which I I have been supplied by the kindness of Major-General Dirom, whose successful cultivation of it on his estate at Mount Annan, is already known to the public.

Progress and present State of Improvement at Chat Moss.

In the year 1805, I obtained from John Trafford, Esq. of Trafford House near Manchester, a lease of such part of Chat moss, as belonged to him, being upwards of 2500 acres, under the authority of an Act of Parliament, enabling him to grant the same for a term of 92 years, under a progressive rent, the ultimate amount of which is 150l. per annum. At that time this tract of land was wholly unproductive, and was unsafe to pass over, except in long continued droughts in the summer season.

In the month of November 1805, I begun the drainage, by cutting out the main drains on each side of the roads; throwing out the moss from the drains into the

middle of the road, so as to raise it, and leave it sufficiently dry for passing over with carts and horses. This operation was continued through the year 1806.

In 1807, I began to cut the smaller drains, diverging from the large drains at fifty yards distance from each other, and forming the boundaries of the fields. About 1000 acres were thus prepared, and the whole of the moss was, in that and the succeeding years, cut at the same distance, so as to be in a progressive state of improvement.

In 1808, the drainage was continued. A part of the moss was now sufficiently consolidated to be worked with horses in pattens. About 50 acres were turned over, part by the plough, and part by the spade, which it was necessary to resort to on account of the inequalities in the surface, occasioned by the turf pits made in getting peat for firing. In the same year, a farm-house, with out-buildings, cottages, smiths' and wheelwrights' shops, &c. were erected; and I began to set marl upon the land prepared for that purpose.

In 1809, I cropped about 20 acres with turnips and oats, of the latter of which I obtained a tolerable produce.

In 1810, I cropped upwards of 80 acres, of which 20 were wheat. The crops of wheat were very various; some remarkably good, others scarcely returned the seed. The causes of this difference were, however, sufficiently obvious.

In 1811, I cropped upwards of 100 acres, chiefly with wheat, and with a considerable increase of produce, although the crops were by no means uniformly good. Until this period, it was my object to effect the improvement without any materials but such as were found or produced upon the moss. The land had been slightly marled, and the crops principally got in with burnt peat, or with the small portion of manure obtained from the horses employed in the labour.

In 1812, I began to increase the quantity of marl, setting about 200 cubic yards upon an acre, and in getting in the crops, made use of manure obtained from the sweeping of the streets in Manchester, setting about 20 tons to the acre, and cropping it with wheat and beans.. These crops much surpassed those of any preceding year, and are superior to most crops on the old farms in the neighbourhood.

In the course of the present year, I shall have brought into cultivation about 160 acres, which will be cropped with wheat, oats, potatoes, and beans. A track of 30 acres of clover appears to be very promising.

The marling is now regularly proceeding at the rate of 100 acres per annum, which will be taken into rotation of crop; and from this year, I expect the improvement will be carried on in an increasing proportion, without any further advance of capital.

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